Why were they pots?

An experimental perspective on the introduction of ceramics in Early Neolithic South Norway.

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"The study of technology allows many of these abstract issues to be brought down to earth and be brought to account." *Ian Hodder 1990.*

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Dictionary

Actualistic: As realistic as is necessary to be representative of past technologies when performing experiments; experimental archaeological term.

BCE: Before Common Era; a neutral alternative to BC.

CE: Common Era; a neutral alternative to AD

Fire cloud: Soot patterns on ceramic surfaces indicating contact with fuel during manufacture or use

1. Introduction

Within European archaeology, ceramics is a dominating artefact group throughout most ages. It saw its early rise as a raw material in the Upper Palaeolithic culture at Dolni Věstonice in the Czech Republic around 26 000 BP, as burnt figurines (Vandiver et al 1989:1002).Approximately 14 000 years later, the first ceramic containers develop in Japan, and in Western Asia, the earliest fired pottery dates to 8300 to 7900 uncalibrated bp (Rice 1999:14-16). In northern Europe pottery is first seen among the Ertebølle-Ellerbek culture around 5600 BP and the neighbouring Linearband-keramik culture at approximately the same time (Mithen 1997:101; Bogucki 1995:89). In Norway, the first pottery emerges around the very Early Neolithic, as will be exemplified by certain sites in the case study below. Around this time, approximately 4000-3900 BCE, pots are scarce and are often found in presumed hunter-gatherer contexts. All the earliest sites with pottery are found along the coast of South Norway (Amundsen 2000:Figur 3). The inquiry to be made in this thesis is why pottery was taken into the material culture in the Norwegian Early Neolithic. Experiments will aid the assessment of the role of ceramics in the hunter-gatherer context of South Norway.

Astonishingly, as the ceramic material is plastic and sets hard, and is therefore possible to shape in a variety of forms, there is one form that is predominant to the extent that we have coined the term "pottery" to equal the term "ceramics". The shape is the pot. It is now the paramount material for tableware across the globe, and on the whole still takes the form of containers.

On some point before the pot was instituted into the material culture, one must assume that various forms of containers have already existed: bags or baskets for gathering foods (see Andersen 1985:68), skins to hold water and for cooking meats as found in Egyptian archaeology (Murray and Derry 1923:129), and in ethnographical reports (Hornell 1942:36) and potentially drinking cups and vessels for storage. To consequently make the pot into a pot required a notion of 'container' beforehand. If people already had containers, why the need to take in a new raw material for fashioning such?

Numerous archaeologists have researched the origins of pottery (Gebauer 1995; Hayden 1995; Rice 1999). It has often been and still is largely associated with the neolithisation and the beginning of sedentism that is assumed to follow the spread of agriculture (Rice 1996:153). To begin with, the pottery was not singled out from the Neolithic 'package' (Armit and Finlayson 1995:267), but recent trends have emerged in viewing pottery as more or less a particular artefact group (Hayden 1990, 1995; Rice 1999). Still, a number of researchers maintain the connection to early agriculture (see Fischer 2002; Jennbert 1984; Prescott 1996; Østmo 2007). The models for introduction of agriculture therefore lends itself to the debate regarding the introduction of pottery, and at this point the socio-economic model that involves exchange networks and conspicuous consumption seems to embrace both the beginnings of farming and the beginnings of pottery in Scandinavia (Amundsen 2000; Bostwick Bjerck 1988; Fischer 2002; Jennbert 1984).

The *pot* is from the beginning of its introduction the dominant form of archaeological ceramic finds across the globe. It must therefore be assumed that it was constructed to contain something. The question raised in this study is why the container shape dominates as a ceramic form. Could it hold an unrivalled functionality when compared with other vessel types and is this the reason for its firm establishment? Numerous studies now consider the symbolic language found in the style of ceramics; their shape and decoration (for example Aikens 1995; Bogucki 1995; Breivik 2006; Gosselain 1992). However, the question remains why ceramics mostly form containers. Was it in fact the pot itself that held the symbolic importance, as is indicated by a number of researchers (Armit and Finlayson 1995:269-271; Arroyo 1995:206; Osborn 1994:149-150), or was it rather its contents that made up the symbols in the form of an introduction of new foods, new types of offerings or new beverages (Fischer 2002:382-383; Prescott 1996:83-84)? The question regarding the relationship between container and contents constitutes part of the debate which will be pursued in this thesis.

To call attention to the relationship between potential contents and a pot's function with regards to these contents, the present author will consider two aspects about ceramics:

1) The utilitarian aspect: the potential of the pot as a practical artefact group
2) The symbolic aspect: the potential of the pot as a non-utilitarian artefact group.

Both aspects can be highlighted through ethnography, ethnoarchaeology and material culture studies, but experimental archaeology provides a good means to exploring the utilitarian aspect in particular by testing performance characteristics of certain types of pottery in relation to a number of tasks. If the pottery is not functional for these tasks, this can be stated through experiments, and thereafter the potential use of the pottery as a symbolic artefact can be put to discussion.

In this investigation, the method of experimental archaeology will be employed to shed light on the notion that pottery was or was not functional as a utility, and that this aspect can suggest why pottery was taken into the material culture of the south Norwegians of the time. In the light of the experimental results, the symbolic aspect of pottery can be examined, through considerations of the finds themselves, their context and recent research into Early Neolithic ceramics. Four sites are chosen to represent a south-western and a south-eastern tradition of ceramics in the Early Neolithic. Their pottery will be replicated to the extent that it needs to be *actualistic*: as realistic as necessary in terms of testing variables from the actual pottery that was made by the people of South Norway. Actualistic pottery in this scenario is pottery of roughly the same shape and size, with the same raw material and the same temper and temper to clay ratio. The pottery for the experiments will not be reconstructed Early Neolithic pottery, rather estimates of a generic pot form from the Early Neolithic will be employed.

The performance characteristics of archaeological finds of pottery should be considered as to what it could have contained or what function it was designed for (Tite 1999:207). However, often only fragments of pots are recovered, and the observable performance characteristics are drastically reduced to identification of clay and temper, wall thickness and possibly method of manufacture, with only qualified guesses about shape and capacity. This is still adequate information in order to set up comparative experiments such as the ones following, if the level of *actuality* is required to be a representation of a generic pot rather than an actual, specific vessel from an archaeological context.

In order to test functionality, the present author will compare what is functional with what was available at the time. Three types of comparative containers have been fashioned to represent organic alternatives found in South Norway at the time; sewn birch bark containers, woven reed baskets and wooden pails. Skin is an option for a container raw material that was not explored as the acquiring and tanning of skin is beyond the time-span of this thesis. Other varieties of baskets such as twig baskets or coiled grass baskets were not explored, since they were thought to be represented by the woven reed baskets as indicative of the basket type – structurally very different from the ceramic pot. No containers from the Early Neolithic in South Norway have survived, and all comparative containers are based on pollen charts and contemporary exemplars from around Europe (see chapter 4). It is likely that alternative container forms existed on sites that yield as little pottery as Norwegian Early Neolithic sites.

To highlight the issue of functionality, three possible manners of using pots will be tested against similar use of other forms of containers that may have existed before or together with ceramics in a hunter-gatherer settlement of northern Europe. The functionality tests are based on archaeological evidence and indications of use. The tasks that will be undertaken are storage of foods (see Hayden 1990:58), cooking with cooking stones (see Woods 1983) and on a hearth (see Koch 1998:117-118), and brewing beer (see Prescott 1996:83-84). The processes of storage, cooking, and brewing/fermentation may all have been done differently or not at all, and in addition there are innumerable other ways of utilising pottery that are beyond the capacity of these experiments and the experimenter. However, the experimental results will shed light on an alternative way of approaching the question of the introduction of ceramics, and consequently contribute to this aspect of archaeological thinking about the Early Neolithic.

1.1. Defining Experimental Archaeology

Experimental archaeology is part of a long, archaeological tradition concerning itself with material culture studies. Being applied sporadically throughout the 19th century, it became firmly established as an archaeological methodology within the tradition of processual archaeology in the 1960s and, therefore, resonates with the processual ideals of a scientific approach to archaeology (Hurcombe 2005:110-111). It is primarily concerned with research into material culture through replicas of artefacts and structures (Reynolds 1999:156-157).

Experimental archaeology takes a practical approach to archaeological research. Archaeologists replicate past technologies and put them to use, reconstruct buildings and investigate use wear or perform functional tests of raw material of various sorts. This closely resembles the *hypothetico-deductive nomological* method that forms the ideal setup for an experiment in experimental archaeology (Reynolds 1999:157), acquired from the natural sciences in the course of processual archaeology.

The hypothetico-deductive nomological approach dictates a formula that first demands a hypothesis (such as «a pot is functional for cooking»), then a test, and finally a deduction of what the test means. This deduction forms the conclusion (Stanford 2004a). It is a logically consistent way of deducing from the general (the hypothesis) to the specific (the test and ultimately the conclusion – «it *is* possible to cook in *this* pot»). An opposite mode of explanation is also considered logical and rational; the *inductive* mode of reasoning that proclaims that based on the premises (specific), the conclusion is likely (general) (Stanford 2004b). Such induction leads to an initial hypothesis. Once the hypothesis is proposed, the experimental process can be initiated.

In the following, the methodology of experimental archaeology will be applied to generic pottery specimens and comparative containers to deduce the level of functionality a pot holds when compared to alternatives. This will aid the interpretation of the role pottery played in the Early Neolithic sites around Svinesund in south-eastern Norway and Slettabø in south-western Norway, where the earliest pottery in Norway is thought to have occurred.

1.2. The archaeological sites

The earliest pottery in Norway so far discovered dates to around 4000-3900 BCE. There are a few sites competing for the earliest occurrence of pottery, such as Auve (Østmo 1997:15) and Kotedalen (Bruen Olsen 1992:141). However, the sites that appear to have the oldest datings are Slettabø – with a Mesolithic food crust dating of 4238 – 4042 BCE (one sigma error) and one food crust dating of 3986 – 3709 BCE (two sigma error) (Glørstad 1996:Figur 3), and the Svinesund site Vestgård 6, ^{14}C dated to 3960-3645 BCE (Jaksland and Tørhaug 2004:Tabell 12). Two other Svinesund sites are also included, based on their similarity to Vestgård 6 in terms of artefact inventory: Vestgård 3 with a ^{14}C dating of 3780-3695 BCE (Johansen 2004b:50) and Vestgård 8, with a shore line and typological dating of approximately 4400 BCE, but without any relevant ^{14}C samples (Johansen 2004a:22). This site was taken into consideration because of the problems with shore line datings, and because the typology may possibly allow for a dating up to 4000 BCE if the ceramics are included in the artefact inventory of the principal settlement (Johansen 2004a:22).

The ceramics on all sites were heavily fragmented with only small amounts excavated. The decorations were not particularly indicative of any ceramic type, but on all four sites the sherds have been interpreted in light of the nearby establishing TRB or Funnel Beaker culture (Glørstad 1996:46; Jaksland and Tørhaug 2004:90,104; Johansen 2004a:21-22; Johansen 2004b:48-49,57; Midgley 1992:,497).

These sites will illucidate the introduction of ceramics in South Norway into the Early Neolithic hunter-gatherer culture. It is assumed that they represent two different traditions (see Amundsen 2000:107-108), and it will be discussed whether the two traditions follow the same pattern for the establishment of pottery as part of the material culture of the people of Slettabø and Vestgård 3, 6 and 8.

1.3. Thesis disposition

The present study will begin with the introduction of the methodology of experimental archaeology. Through studying material culture in this way, the concept of *chaîne opératoire* is considered valuable. Applying a *chaîne opératoire* should not forget that there are always people behind such a procedure, and therefore the present author will proceed to discuss the agency of past people as seen through recent theoretical literature in archaeology.

The ceramic material as a raw material and a research material will be the topic of the following sections, together with a description of the finds from Svinesund and Slettabø. The necessary preparations for the experiments will be recounted in a separate chapter, and thereafter the actual experiments and their results will be related. Finally, the results will be discussed in light of the utilitarian aspect and the symbolic aspect as mentioned earlier.

2. Method and Theory

2.1. Methods: Guidelines for the execution of experiments

Even if experimental archaeology was firmly established in the environment of processual archaeology in the 1960's, experiments are being performed on all aspects of technology (See EXAR 2007) and incorporated in more post-processual approaches as an aspect to past cultures. Experimental methodology in archaeology is not incompatible with the interpretational aspects of our subject field as long as the resulting analysis is accomplished through incorporating general archaeological interpretational practice (Coles 1973:17).

Experimental archaeologist Peter Kelterborn (1987) is one of the few to propose a check list of four key issues every experimental archaeologist should address. His key issue 1 sets guidelines for when an experiment agrees with today's accepted scientific standard: clearly goal oriented, measurable, repeatable, professionally planned and supervised and executed with expert manual skill. Key issue 2 guides the experimenter through a model check list for practical preparations, of which should be noted to conduct the experiment, analyse, evaluate and conclude, and to document, store and report the results. Key issue 3 concerns the quality of the experiment, and requires a fundamental understanding of the technology in question, familiarity with the experimental methodology, practical skill and previous experience in the particular activity studied, plus organizational and creative abilities. Key issue 4 gives examples of various ideal strategies that can lead to success in different situations. Some of these guidelines can easily be taken advantage of, as the advice to start the experiment right away, which is stated to be a good strategy when a problem is very new. One should also try to isolate each of the problems to address, and to define which relevant information that should be measured in relation to the particular questions (Kelterborn 1987:11-12).

Peter Reynolds was the founder of Butser Ancient Farm in England, and devoted most of his career to experimental archaeological research. Kelterborn's key issue 1 is compatible with what Reynolds (1999:157-158) sees as ideals for experimental research; that they be carefully planned, repeatable and according to the hypothetico-deductive method. Reynolds also argues to substitute the term 'hypothesis' for 'interpretation', and completely remove the human element.

In contrast to this strict focus on scientific processing, Kelterborn's key issue 3 is more congruous with the perspective taken by John Coles (1973:15-18), who suggests a focus on the quality of the experiment. He, too, includes features such as planning and replicability to his list of ideals for conducting experiments, but to Coles, important preconditions are the authenticity of the raw material and the methods for manufacture and use, when considering resource availability and technological competence of the archaeological society in question. Coles expresses the uncertainty that any archaeological interpretation will yield: no absolute conclusions should be made, even if an hypothesis has been confirmed. He also specifies that improvisation must constantly be considered during the course of the experiment, and that "the 'disciplined use of imagination is the highest function of an archaeologist'". This is so that the hypothesis should not be maintained to the extent of severe prejudice (Coles 1973:17).

Coles' last directive is to ascertain a wide evaluation of the experimental process in terms of reliability, methodology, and honesty in reporting and interpreting results. However, he states:

> *"And in the final analysis, the reliability of experimentally-derived conclusions must not be assumed. It may be possible to produce fifteen musical notes or noises from a prehistoric horn, but it is not possible, by experiment or any other archaeological procedure, to assert therefore that the landscape of Denmark in about 800 BC reverberated to the multifarious notes of these splendid instruments" (Coles 1973:18).*

Reynolds conforms to the trend of positivist archaeologies that base their truths on causal principles and economic and material concepts (see Skibo 1992:18). The rationale is supposed to be valid for societies of the past, and a logical, objective form or reasoning is, therefore, assumed to exist in all humans, independent of temporal or spatial context (Dommasnes 1988:122-123). This is consistent with a the view that temporality need not be considered, since the archaeological record is a set of "observationally static facts" (Binford 1977:6). Such generalisation leads to the notion of time as a key factor being ejected out of archaeology – a paradox for a cultural-historical discipline (Barrett 1988:7).

2.2. Theory: Approaching choices

2.2.1. The chaîne opératoire

When dealing with technology through experiments and similar material techniques, a frequently used approach is the *chaîne opératoire.* The approach can be defined as the successive trajectory an artefact undergoes from its emergence with the sourcing of raw material to finished state to use, reworking and finally abandonment (Sillar and Tite 2000:4). However, apart from its sequential nature, the *chaîne opératoire* has been described in numerous ways (Audouze 1999:169), but the traditional definition for archaeology was made by André Leroi-Gourhan. His wording can be translated into: "The technique is at the same time action and instrument, organized in a chain through a set of rules that provides the series of operations with both stability and flexibility"(Pélegrin et al 1988:57, my translation).

The *chaîne opératoire* approach includes three components (Pélegrin et al 1988):

- The material objects through which the action is observed
- The set of gestures used to process the material objects
- The specific knowledge needed to navigate through the sequence.

The *chaîne opératoire* approach can help the analysis of archaeological data in terms of defining stages in the sequence and disclose which information is missing. It can also aid in understanding which gestures lie behind a certain product, and point to the body of knowledge and cognitive skill that is necessary for approaching a certain *chaîne opératoire* (Pélegrin et al 1988:56-57; Pélegrin 1990:117-118).

Often approached through the part of the sequence concerning manufacture, the *chaîne opératoire* has a much wider range; the subsequent use of an artefact, for practical or social purposes, is another part of the chain (Figure 1). This part is often inferred from our wide ability to associate when we are given a finished product, and even less effort is invested in the interpretation if the artefact in question has a corresponding appearance to artefacts we know from our contemporary society: a pot is for containing something (Sillar and Tite 2000:3). However, in spite of our familiarity with a similar artefact group, this part of the *chaîne opératoire* may well be of a different character, and it can be beneficial to experiment with even the assumed utilitarian section of the sequence. Was the pot actually meant to contain something and something in particular? Other inferences are more difficult to approach by experiments or material culture studies, such as statements about social behaviour. Nevertheless, even hypotheses like these can be placed under experimental scrutiny through Karl Popper's falsification approach (Popper 2002 [1935]:70,72,246). This approach dictates that an experiment can only ever falsify a result, because a validation will always have the potential to be falsified at a later stage due to different approaches and new technology. A number of experiments are in reality falsification experiments as they produce results allowing us to conclude that something *is not* a viable hypothesis (Hurcombe 2005:112).

Object	**Gesture**	**Body of knowledge**
Sourcing raw material	Collecting clay, temper, flux	Considerations of suitability, locations
Preparing raw material	Cleaning clay, preparing t emper and flux	Considerations of suitable malleability, durability, resistance
Forming raw material	Coil-, ringbuilding, pinching. Drying.	Technical considerations, shape
Shaping raw material	Finishing techniques, decoration. Firing.	Technical considerations, style
Using product	**?**	Considerations about functionality.
Maintaining product	**?**	Considerations about wear.
Discarding product	**?**	Considerations about appropriability or functionality.

Figure 1: The Chaîne Opératoire for pottery production and use

As with experimental methodology, the aspect of the *chaîne opératoire* was instituted in the age of cultural-historical archaeology and is, therefore, firmly established within the processual framework. Research has previously engaged itself more or less with the functional and practical aspects of artefacts in light of environmental and evolutionary factors, and a number of researchers are still performing functional analyses without consideration of the underlying social agency (Dobres and Hoffmann 1999:1; see also Bronitsky and Hamer 1986; Hally 1986; Smith 1988). But the major trend that has emerged with post-processual archaeology is the notion that material culture can be an active social component (for example DeCorse 1994; Hodder 1982; Soffer and Conkey 1997:3-4). From this follows that the body of knowledge behind the material culture has to be regarded as socially influenced, and should be taken into consideration when examining a *chaîne opératoire* (Dobres 2000:115-116;169). The underlying intention with the manufacture of the artefact can actually determine the *chaîne opératoire* – for example, a pot meant for display can be elaborately decorated but not very functional in terms of shape, firing or clay matrix. Considering the *chaîne opératoire* in this light can yield information about the purpose of that artefact, or, through experiments, even what was *not* intended as its purpose (Dobres 2000:169; Sillar and Tite 2000:2,5-7).

With the interest in the body of knowledge behind a technological choice, the agents themselves are being put under scrutiny. The distinction between discursive and practical knowledge is highlighted (Dobres 2000:110), and at the same time, the boundaries between thought and action are being erased (Hodder 1990a:155, 156). Motor and cognitive skills are investigated to elucidate the social context, as in Jacques Pélegrin's analysis of levels of flint knapping skills and the implication of craft specialisation in the Neolithic (Pélegrin 1990:123). However, the integration of conscious, subconscious and unconscious thought into action is complete and cannot be isolated from the act of an agent, so it will not simply be a matter of mastering a skill that determines who is a specialist. Within this societal body of thought lies individual preferences and choices, but also the social prerequisites for living in a particular society such as norms, ethics and aesthetics (Dobres 2000:85-86; Hodder 1982: Hodder 2000:22; Shanks and Tilley 1992:125,253; Torrence and van der Leeuw 1989:4).

2.2.2. Agency theories

As a natural extension to the *chaîne opératoire* approach, a number of archaeologists are now considering the agency that lies beneath all technological choices (e.g. Dobres 2000; Edmonds 1990; Gilchrist 1994; Knappett 2005; Sillar and Tite 2000). This, together with the hermeneutic foundation in social science and archaeology, and the development of contextual and post-processual archaeology, has made many archaeologists contemplate the personhood of our subjects of study (Dornan 2002:303-304; Hodder 1986:158). Such an approach has led to the development of agency theories, placing the focus of attention on human abilities of freely acting out whatever they choose (consciously or not) in the centre of attention. One definition of agency from the archaeological discourse is "the means by which things are achieved" (Barrett 2000:141), which immediately resonates with human willpower. The definition can be broadened, and may include both organisations or even abstract principles such as law or ethics (Meyer and Jepperson 2000:101). Most agency theories criticise positivism and the belief that we – the researchers with the superlative methods – can directly observe patterns of action in material culture (Dornan 2002:304). Instead, it should be acknowledged that we at most make interpretations about behaviour, and that we have to consider the context of that behaviour closely in order to make any statements at all (Hodder 1986:150-151).

Agency theories as used today, take many forms (Dornan 2002:315-317). All but a few arguably take the view to its, most logical, but least observable conclusion: the individual. To identify an individual except for traces such as their fingerprint on pottery is extremely difficult using archaeological methods (Dornan 2002:311). Instead, most tend to look at shared practice or a more 'generic' or representative individual, because someone's psychological, intellectual and even unconscious ('instinctive') mind is virtually indecipherable: looking at personhood only really justifies studies of actions which are, most likely, the same for everyone, like biological necessities. This is also consistent with most agency theories' attention to social structures and structuration, and the notion that these cannot be separated (Dornan 2002:311, 315-317).

Agency theory concerns itself with the deconstruction of dichotomies such as *society – individual, material-social* and *structure-agency*. Society is seen as incorporated in individuals through their agency – the individuals create society by structuring it, and society is therefore reliant on the individuals rather than the other way around (Barrrett 2001:148-149). This means that people are products of their culture which again is the product of its people. It is within this structuration process (Giddens 2001:668) that all *chaînes opératoires* take place, and consequently the technological choices refer to and infer from their social context. This also means that the *chaîne opératoire* will hold information about the social context, and should therefore be of considerable value to archaeologists (Dobres 2000:168-169).

2.2.3. The chaîne opératoire and agency theories united

One general interest of archaeology is to understand actions and signification rather than just things. Are they functional and/or symbolic? Are they signifiers at all or merely waste products? An agency focussed *chaîne opératoire* approach will be able to shed light on these questions through its consideration of choices within an overall context that considers mode of production, environmental factors and the knowledge we have of the social system (Sillar and Tite 2000:4-7). for example: is the pottery produced within a household or a workshop context? Is it made of local raw material or is some or all of it imported, maybe through networks that are already established archaeologically? All these considerations can implicate the intention behind the finished artefact. Jennifer Dornan (2002:309) claims that the concern with agency has broadened the analytical abilities of archaeological research when it comes to addressing 'new' aspects of past societies.

Often, archaeologists dealing with agency come from or aim at practice-based approaches which focusses on everyday life, including routines, norms and traditions, which may have to do with an individual's experience of the world through day-to-day behaviour (Siliman 2001:191, 196). However, considering agency in an analytical sense explicitly requires informed methodologies that can address this agency (Dobres and Robb 2000:3). Many archaeologists acknowledge this, and most try to form an approach to grasp the volatile concept that is past agency and its significance for the broader community (e.g. Bell 1992; Meskell 2002:59,109,133; Pauketat 2001:86f). However, even with only a basic knowledge of a *chaîne opératoire*, and a will to look deeper into such technological choices, research can advance towards the agency of past societies through Archaeology's main object of study: the material culture.

The application of agency theory in conjunction with the *chaîne opératoire* approach is a way of reconnecting the people with their the material culture. As a theoretical approach to practicality, this should form a natural part of experimental archaeology. To experiment with the functionality of ceramics without considering the agency that influenced the whole concept of 'functionality', will only lead to a study that proclaims how prehistoric pottery is functional or impractical in terms of modern concepts of 'function'. To try and contextualise through wider studies of prehistoric societies what the different functions for a pot may have been, will highlight such agency and give a result that can be taken into consideration in a wider discourse.

3. The Ceramic Material

3.1. Ceramics in Archaeology

Ceramics are generally introduced in Stone Age societies around Europe just before, during or just after the introduction of agriculture. This has led to ceramics often being seen as one of the markers of 'neolithisation', as it is taken to imply sedentism which is again seen as coinciding with an agro-pastoral lifestyle rather than a hunter-gatherer culture (Prescott 1995:77-78; Tite 1999:211-212). With numerous finds of pottery providing evidence to question the apparent link to agriculture, the criteria have been reduced to only that of a partial sedentism. It is assumed that the production process alone requires that one group of people needs to spend time "close to appropriate clay sources and under suitable climatic conditions, to allow time for collecting raw materials and for forming, drying, and firing the vessels" (Tite 1999:212). Another argument favouring a more sedentary lifestyle is that pottery is impractical to carry when travelling, because of its fragility and may break and spill the contents (Eerkens 2003:729; Rice 1999:8,28). None of the arguments do in reality maintain sedentism as a requirement for pottery production and use: the sourcing, cleaning, and preparing of clay, the forming, drying and firing process can be done in as little as one week in Sub-Saharan Africa (Tobert 1984:143). In less dry climates, the crucial drying processes can likely be done in 3-4 weeks, and less if dried inside a living space with a fireplace. A total of 6 weeks is likely to be adequate for the entire manufacture process in colder, wetter climates. In summary, this is not enough time to argue successfully for semi-sedentism.

The pottery at Svinesund and Slettabø are assumed to be from hunter-gatherer contexts, and is, therefore, probably found in a seasonally mobile community. Archaeologically observed mobile hunter-gatherer cultures with pottery as part of their material culture include the Mesolithic Ertebølle-Ellerbek cultures (Vandiver et al 1989:1002) – although possibly semi-sedentary (Larsson 1990:291), the hunter-gatherers from North Eastern Congo around 950-1000 CE (Mercader et al 2000:163,168), the hunter-gatherer cultures at Enkapune Ya Muto in Kenya around 4800 uncalibrated bp (Marean 1992:123) and generally all North African early pottery is found among what seems to be semisedentary to highly mobile people (Close 1995:23). Ethnographically documented, the mobile hunter-gatherer *Paiute* and *Shoshone* tribes of in North-West America had pottery (Steward 1933:240), as did the *Okiek* of Kenya (Blackburn 1973:55) and the !Kung bushmen of southern Africa (Metz et al 1971:230). It can no longer be claimed that a criterion for having pottery is sedentism.

When it comes to analysing the introduction of ceramics, a vast amount of work has already been done. However, it is common to encounter these analyses from the "neolithisation"-aspect, or rather what was traditionally seen as the introduction of agriculture (see for example Amundsen 2000; Barker 2006:74; Gebauer 1995; Larsson 2007:603; Østmo 1988:33). Traditionally, ceramics was and is seen as part of the Neolithic 'package' (Prescott 1996:79), and to equal it with agriculture has often been done unreflectively (see for example Skjølsvold 1977:183).

TRB, or Funnel Beaker, culture settlements were found around 4000 BCE in South Scandinavia and northern Germany. The TRB is a complex, sedentary culture which in this area is characterised by agricultural subsistence patterns, ground flint axes, pottery, and monuments such as long barrows around 4000 BCE (Midgley 1992:212,263; Solberg 1989:267-274), in other ways it has incorporated the Neolithic 'package' (see Armit and Finlayson 1995:267).

To sum up the history of Early Neolithic ceramic studies in southern Norway the previous years, one can point to the establishing of a chronology as the first and foremost priority. With finds from several regions in South Norway, Erik Hinsch repudiated the earlier assumption that ceramics were rare in the Neolithic (Hinsch 1955,1956). His work indicated the presence of the pitted ware complex and there were also tendencies that pointed to TRB influenced ceramics (Hinsch 1955:90,94).

A framework instituted by Anathon Bjørn, Guttorm Gjessing and later Hinsch was employed for analysing Neolithic ceramics the next two decades. The main component of this scheme was the comparison with South-Scandinavian ceramics as a fixed point of reference. This lead to early datings and peculiar decorative elements being forced into South-Scandinavian chronological schemes, even if the fit was only partial (Glørstad 1996:4). This tendency was more or less disrupted in the 1980's when Einar Østmo started focussing on potential local ceramic traditions, represented by the excavation of a vast ceramic material at Auve, Vestfold (Østmo 1983:54-57). This focus is adhered to by Arne Johan Nærøy, who divides the Ramvikneset ceramic assemblage from Hordaland into one imported group and one locally produced group of pots (Nærøy 1987:134). Asle Bruen-Olsen follows his scheme with the analysis of the Kotedalen assemblage, and thereby creates a chronology that may supposedly be applied for all South-Norwegian finds (Bruen-Olsen 1992:140).

Kristina Jennbert's work (1984) has since had repercussions for the debate on introduction of ceramics in Scandinavian Neolithic research. She discussed how the change in ceramics can be seen to be gradual in a number of Scanian Mesolithic/Neolithic sites, and how the Neolithic funnel beaker pots are contemporary with Mesolithic Ertebølle-culture pottery. There is a distinct difference in the two types, mostly manufactural. There is seemingly no distinction regarding their use (Jennbert 1984:45-51). From this she establishes that the introduction of Neolithic pottery most likely had little to do with the immigration of new people, and that such pottery was gradually taken into an already existing material culture. Jennbert equals funnel beaker pottery to an agrarian context, and goes on to discuss how the agro-pastoral subsistence pattern was introduced to Scania. Her conclusion is that a wide network of gift based alliances traded or gave seed and domesticated animals through this network and that it was taken in on grounds of prestige, not as a subsistence necessity, as the Mesolithic Ertebølle sites were located in plentiful surroundings for hunting and gathering (Jennbert 1984:147-148).

One feature is characteristic of a large amount of ceramic research, and Norwegian and Scandinavian ceramic analyses in particular. The focus is always on typology and chronology, rarely about the pots themselves. The question "Why are the pots pots?" is not the centre of attention, the focus is rather on what the pottery symbolises regarding ethnicity. As social markers, ceramics are fundamental. But why they do not take other forms, such as disks, figurines or other non-functional forms, is barely reflected upon. Carl Knappett (2007:22) could easily include this situation when he states: "...it seems the ethnographer or sociologist struggles to see through the web of social relations to materials and their properties".

Even so, numerous experimental studies have been undertaken with regards to archaeological ceramics. However, most are concerned with manufacture, such as the formula for shaping specific vessels (Edwards and Jacobs 1986; Rye 1981) the choice of temper (Bronitsky and Hamer 1986; Jeffra 2008; Skibo et al 1989), firing procedures and temperature (Bryant 1970; Gosselain 1991, Livingstone-Smith 2001), firing temperatures and colour (Mirti and Davit 2004), and decorations (Braunholtz 1934, and see Skjølsvold 1977:78-79). A few experiments have dealt with function (Ericson et al 1972; Hendrickson and McDonald 1983; Smith 1988). Eva Koch states that it "is a relatively new development for archaeologists to concern themselves with the uses of ceramics"

(Koch 1998:115). Experiments dealing with the functionality of certain ceramics have seemingly not been published on Scandinavian TRB material, but some cooking experiments have been undertaken on the Ertebølle-ceramics that preceded TRB ceramics in Denmark (Klinge 1932 and 1934, cited in Andersen and Malmros 1985:81-83), although not with actualistic raw materials as the clay was untempered. The Ertebølle-"lamps" have also been subject to experiments, that seemingly confirmed their use as blubber lamps (Van Diest 1981). Experiments in Norway are restricted to decoration and impressions (Skjølsvold 1977:Fig 32-33).

The lack of functionality studies and the abundance of typological-symbolic approaches may be a symptom of the general movement from scientific to contextual analyses that followed the theoretical transition from processual to post-processual archaeology. However, to stop researching function completely will only exclude an important aspect from the archaeological picture. Of course, ceramics may very well have limitless social meaning, but one must not overlook the fact that most archaeological and modern ceramic products are pots or containers. The symbolic behaviour – the agency of the past people – is also expressed in the way in which these vessels were used, and this is the purpose of the experimental study that I will present in the following. The study will consider the utilitarian aspect of the vessels, and therefore make interpretations of people's agency concerning what was "practical". The results will be discussed in light of the ongoing Scandinavian debate about introduction of ceramics in the Neolithic.

3.2. The ceramic raw material

Clay is defined as depositions with grains less than 2 micrometers in size, making it the smallest grained of any soil type. Most clays are hydrous aluminium silicates which has a platelet shaped particle structure that binds water effectively between the platelets. The platelets form wafers in two or three layers, and a number of wafers will form a clay crystal. The combination of the different ratios of silica to aluminia and the water content are what determines different clay types. In addition, numerous trace elements, such as iron oxides and magnesia, can lead to specific characteristics in clays. The ability to retain water between crystals results in clay's colloid-like behaviour and plasticity which again leads to its easy manipulation (Henderson 2000:112-113).

There are three principal forms of clay used to form vessels: Kaolinite, deposited from granite, a two-layered clay that forms the basis of porcelain and has low plasticity due to only one layer of water between platelets; illite, deposited from mica, a three-layered clay with medium plasticity; and smectite, deposited from basalts, a three-layered clay similar to illite that due to its small particle size is very plastic (Henderson 2000:114). Illites and smectites are often mixed if available, alternatively plasticity can be corrected by the addition of temper (Gosselain, personal communication 2008).

When clay is dried, the adsorbed water that surround the clay platelets and provides lubrication starts to evaporate. The clay platelets will eventually be adhering to each other and the lubrication, and hence the plasticity, is lost. Some of the water added during forming will evaporate from pores, and can result in cracks if dried up too rapidly. The clay shrinks in volume when water is lost; in some clays the water content can rise up to 35% (Henderson 2000:113,128). Clay reaches a 'leather hard state' which is when most decoration is completed. The clay is still damp, but no longer warps unless considerable force is applied. After this, most pots are allowed to dry until they feel dry to the touch (Gibson and Woods 1997:202). The chemically bound water which is an integral part of the clay particles is not lost during drying. To evaporate, this needs to be brought to higher temperatures, a process called *water smoking* (Hodges 1989:22,39).

Ceramics only become ceramics when heated to and held at a thermal threshold for a certain period of time, also known as the maturing point. The firing temperature necessary depends on the clay and the different fluxes added naturally or intentionally, but generally speaking *terracotta* is fired to a maximum of 1000ºC (bonfire fired), and *earthenware* between 1000ºC and 1200ºC. *Stoneware* is fired between 1200ºC and 1300ºC, but is of a different constitution that is hardly encountered in archaeological contexts (Hodges 1989:39-40). The irreversible state of 'ceramic', the point where the clay undergoes molecular changes that will only allow it to adsorb water mechanically, is reached at approximately 550º-600ºC for terracotta and earthenware (Gibson and Woods 1997:120; Tomlinson ----:238). Since terracotta is fired to maximum 1000ºC, the process of *vitrification* – theorto melting of clay leading to a glassy state that is no longer able to hold its shape – seldom occurs. This normally begins around 900ºC, but will vary with the type of clay in question. However, *sintering* – when clay particles start to soften and stick together and eventually fuse, and which initiates the vitrification, can begin before this and is inversely proportionate to the particle size. This means that smectites can sinter before kaolinites. Sintering produces a harder and more rigid body (Gibson and Woods 1997:248; Henderson 2000:132-133).

During firing, water loss and burn-out of organic components will result in shrinkage, together with the breakdown of inorganic inclusions. These processes produce gasses that can cause cracks and breaks when escaping the ceramic. Sherds demonstrate a black core when oxidation of organic components is incomplete (Henderson 2000:132). The burn-out of organic compounds starts at approximately 200ºC and continues to 1000ºC is reached in high organic clays (Johnson et al 1988:408).

3.3. Neolithic Ceramics from South-eastern and South-western Norway

The three sites from Svinesund were chosen on the basis that they are sites from the transition of the Late Mesolithic to the Early Neolithic with pottery. Two of them (Vestgård 6 and 3) are interpreted as Early Neolithic due to the presence of ceramics and a few fragments of polished flint axes (Jaksland and Tørhaug 2004:142; Johansen 2004b:64). The third (Vestgård 8) is interpreted as a Late Mesolithic site with a secondary deposition of ceramics (Johansen 2004a:30). However, this site was not ^{14}C-dated, and its artefact inventory quite resembles that on both of the other sites that are interpreted as transitory (Jaksland and Tørhaug 2004:142; Johansen 2004b:64). The presence of ceramics in this context is potentially very interesting, as the potsherds have been interpreted as bearing resemblance to Early Neolithic TRB (Johansen 2004a:21-22). The Svinesund sites are located in the South-eastern part of Norway, in Østfold county, and are therefore chosen to represent a south-easterly tradition.

The Slettabø site has been subject to a generous amount of scrutiny (Glørstad 1996:21). Three distinct layers were discovered during excavation. The bottom layer, layer III, was thought to belong to a pre-ceramic hunter-gatherer phase (Skjølsvold 1977:180-183), although it produced 315 sherds of ceramic. Food crusts have later dated some of the sherds to 4200-3900 BCE (Glørstad 1996:Figur 3). The artefact inventory points to a hunter-gatherer settlement, together with the coastal location (Skjølsvold 1977:183, Fig 48). Slettabø is chosen to represent a south-westerly tradition.

3.3.1. Svinesund: Three hunter-gatherer sites with ceramics

Vestgård 6, 3 and 8 were three sites discovered during the excavations of the E18-road area at

Svinesund, Østfold. All three sites were placed typologically to the transition from the Mesolithic to the Neolithic and share sparse finds of what is presumably Funnel Neck Beaker, or TRB (from german: *Trichterbecher*) related ceramics.

The dating of the sites is done based on shore-line and typological dating (Vestgård 8) and 14C-dating (Vestgård 3 and 6). The datings can be seen in Table 1.

Site	Dating
Vestgård 8	4400 BCE (shoreline and typology)
Vestgård 6	3960-3645 BCE (^{14}C)
Vestgård 3	3780-3695 (^{14}C)

Table 1: Datings of the chosen Svinesund settlements

The sites are located at presumed shore lines 30, 32 and 37 m above sea level respectively (Jaksland and Tørhaug 2004:Figur 36; Johansen 2004a:Figur 4, 2004b:Figur 15). This means that Vestgård 6 is assumed youngest, thereafter Vestgård 3, with Vestgård 8 as the oldest presumed settlement based on shoreline dating (Glørstad (ed) 2004:193). However, there are some issues with shoreline dating, such as the problems with creating reliable shoreline displacement curves and if the site in question was really located at the shore (Sognnes 2003:191-192).

Neither of the three sites have any trace of agriculture. Neither has pollen analysis yielded much evidence for agriculture in this region in the Early Neolithic, except for three pollen grains of *Plantago lanceolata* in the Gunnhildsmyra bog (Danielsen 1970:Plates). The sites' coastal location and bones of elk, ruminants and seabirds together with the large amount of arrowheads and other presumed hunting equipment found such as a likely fish hook, point to a hunter-gatherer situation for all three sites (Jaksland and Tørhaug 2004:141, Johansen 2004a:30, 2004b:64). The ceramics therefore provide an interesting perspective to the traditional correspondence between ceramics and agriculture (see Johansen 2004b:64).

The sites were different in size, with Vestgård 6 being the largest and possibly settled over 100-200 years reapatably by seasonally migrating groups (Jaksland and Tørhaug 2004:140-141). Vestgård 3 might have been used several times in the Early Neolithic (Johansen 2004b:64), the number of finds being less than half that of Vestgård 6. Vestgård 8 is also likely to have been used more than once (Johansen 2004a:30).

With courtesy of the Museum of Cultural History in Oslo, I was allowed to look at the finds from Vestgård 3, 6 and 8 under a low power binocular microscope. All fragments were examined at 40x magnification. I was principally looking to determine the temper which on all three sites was pronounced granite after an initial examination (Johansen 2004a:21, 2004b:47; Jaksland and Tørhaug 2004: 89,104). I compared the temper with crumbs of burnt granite. The temper resembled the experimental specimen in all samples.

Vestgård 3/C53860 has been ^{14}C dated to BCE 3780-3695 and shoreline dated to BCE 3900 (Johansen 2004b:58). Typological dating indicates the transition between late Mesolithic and early Neolithic technology, except for two fragments of a ground flint axe, possibly thin butted, and the ceramics. Both these artefact groups traditionally point to the early Neolithic.

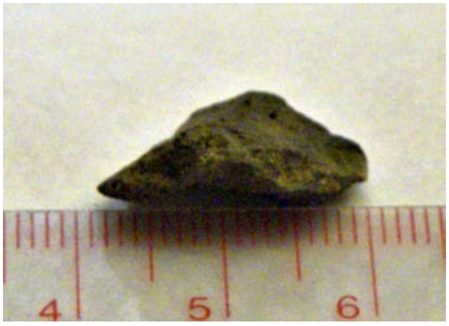

Figure 2: C53860/56. Vestgård 3. Shoulder sherd.

267 sherds were found, most smaller than 2 cm (Johansen 2004:47). One sherd is decidedly a shoulder sherd (Figure 2), 19 are rim sherds and four have been diagnosed as belly sherds. 242 sherds have not been identified as either. Five sherds have decoration possibly resulting from stick and cord impressions and this places them in the earliest TRB-phase according to Scanian typology. Four sherds have lines incised in the rim. The typology also matches Kochs type II and III, which is dated to Early Neolithic phase 1 (4000-3500 BCE). Based on Southern Scandinavian typologies, the Vestgård 3 ceramics are placed in this phase of the Early Neolithic (Johansen 2004:48-49).

Figure 3: C53860/55. Vestgård 3. Rim sherds.

The sherds display a variety of appearances regarding colour and wall thickness. Some sherds are dark, almost black, and may have been in contact with fuel during firing. No fire clouds are visible. A number of sherds are smoothed with moisture, so that the temper is brought to the surface. Striations from smoothing with fingertips are seen. One sherd has been evened out without bringing out the temper, possibly with a damp cloth or in a leather hard state. One belly sherd displays some degree of wafering, which can point to applied pressure during manufacture. Generally, the clay and temper mixture seems well incorporated through kneading. According to the sight report, eight sherds have an assumed food crust on the interior surface (Johansen 2004:47).

Based on colour and thickness, the sherds seem to represent approximately 4-5 pots. The shoulder sherd stands out with its lack of similarity to the remainder of the sherds. The colour is greyish-black and it is the thinnest sherd found on Vestgård 3, only a maximum of 5 mm thick at the shoulder. The sherd presents a marked shoulder between belly and neck. This may indicate a funnel shaped rim as seen in certain TRB-vessels, for example the Oxie group of Zealand in Denmark (Midgley 1992:Figure 34).

One group of three rim sherds have been set together (Figure 3). They exhibit a plain, almost straight wall, with no sign of a funnel neck except for a very slight thickening at the rim. The sherds are only 4 mm thick and the clay is very well blended. The outer surface is smoothed and finger striations are visible. The curvature points to a diameter of 15 cm.

Figure 4: C53862/46. Vestgård 6 site 1. Potsherds with insufficiently burnt core.

The site of *Vestgård 6/C53859* and *C53862* is dated to BCE 3940-3785 to 3700-3645 by means of ^{14}C and was divided into two sites when excavating. The sites are assumed contemporary, and dominated by late Mesolithic technology, apart from fragments of what appears to be an early Neolithic point butted axe type and the ceramics (Jaksland and Tørhaug 2004:140). Vestgård 6, site 1 produced 242 ceramic sherds. Site 2 yielded what seems to be sherds of only one pot, with a total of 30 sherds.

Site 1 delivered sherds that seem to a large extent to originate from the same clay source. The colour is yellowish brown and the clay seems well-prepared with a proficiently incorporated temper. A few sherds are of a different appearance, which can have to do either with the clay source or the firing. The sherds exhibit a different colour, and some are black in centre but brown on both surfaces. This can point to insufficient burn-out of organic matter (Figure 4).

Figure 5: C53862/44. Vestgård 6 site 1. Possible impression of snail shell.

Some of the sherds, all rim sherds, have a rather plain decoration of line impressions along the edge which are interpreted as nail impressions (Jaksland and Tørhaug 2004:90). One sherd displays a hollow that may be the result of an impression with a snail shell (Figure 5). The impression seems to be on the inside of the vessel, but the curvature is too straight to determine clearly. The opposite side – the potential outer surface – is smoothed. The most likely explanation for the impressed hole is as a fixture for an applied handle or lug. The impression does not display any wear around the edges or along its walls on any magnification up to 40x.

Some of the sherds from site 1 can possibly correspond to the early Neolithic Oxie group of vessels from the South Scandinavian TRB Culture (Jaksland and Tørhaug 2004:90).

All the sherds from site 2 are yellow in colour, and the clay matrix is dense without visible holes and cracks. This implies a mixture of clay and temper that is well incorporated through kneading; air has been expelled from the clay. The appearance both macro- and microscopically at 40x leans towards this being the fragments of one pot. The sherds were also found rather concentrated (Jaksland and Tørhaug 2004:Figur 76). The colour and decoration separates this pot from the sherds from site 1.

Figure 6: C53859/55. Vestgård 6 site 2."Wafer" structure might indicate pressure during manufacture..

A quick measurement of the curvature shows approximately 24 cm Ø. The vessel has a protuberant coil-like rim and is decorated below it with short, diagonal marks that has the appearance of cord-impression (Figure 6). All decorated sherds are of the same character. None of the sherds appear surface treated, but the outer surface is smooth and the wall thickness is a uniform 8 mm to 1 cm on all sherds. One of the sherds is approximately 1,5 cm thick and may be a sherd from the vessel bottom. One undefined sherd is smoothed on what appears to be the inside according to the curvature. This may be a possible remnant of a neck. The pot bears close resemblance to the South Scandinavian Early Neolithic TRB-vessels of Eva Koch's type II and III (Koch 1998:89-94).

The site report states that the vessel is rough and poorly fired (Jaksland and Tørhaug 2004:89,104), which seems to not be the case. Rather the sherds give the impression of dense and well fired pottery. There are no fire clouds on the outer surface, and the vessel may therefore have been fired under a cover. The manufacture technique is difficult to assess without creating fresh breaks in the sherds, which was not allowed by the museum. Neither has thin section analysis been performed on the sherds. However, some of the sherds, including C53859/55, display a wafer-like structure observable even in some of the substantially eroded breaks. As demonstrated by Marie-Agnés Courty and Valentine Roux at a ceramic workshop at Witwatersrand University in December 2008, such patterns point to the application of pressure during manufacture, which could indicate a paddle-and-anvil technique for shaping an already coiled rough-out of the pot. Alternatively, the pressure applied when shaping and smoothing may have been substantial. However, this is a feature that is more likely to be expected in vessel bottoms. The wafering is visible in Figure 6 where indicated.

Vestgård 8/C53861 is a presumable Mesolithic site, dated through shore line and typology to approximately BCE 4400. No applicable ^{14}C-dates were sampled. The ceramics found were regarded as secondary deposited material (Johansen 2004:30).

The site produced 43 sherds of a similar décor and colouring to C53859/Vestgård 6 site 2 (Figure 7). The site shares transverse arrowheads and 'arrow shaft scrapers' with Vestgård 6. As already noted, the site 2 of this site yielded a small amount of ceramics and fragments of a ground flint axe, plus a small number of A-arrowheads. The remainder of the material bears resemblance to the material from Vestgård 8. However, the presence of grinding stones and absence of A-points seems to fix Vestgård 8 in the Mesolithic. Regardless, it is difficult to firmly place Vestgård 8 in a different time scale than Vestgård 6 based on this alone, and the question of similarity between ceramic assemblages remains unanswered.

A substantial number of micro blades together with transverse arrowheads and grinding stones may be diagnostic for the last phase of the Mesolithic in the region (Johansen 2004:27). However, there is some evidence of intentional macro blade production on large flint nodules (Johansen 2004:13), which are not normally found along the Norwegian coast in the late Mesolithic.
It is therefore possible that trade routes have already opened along the Scandinavian shores.

Figure 7: C53861/32. Vestgård 8. Rim sherd with cord impressions.

The ceramics from Vestgård 8 seem to be from the same vessel or near identical vessels. The sherds are of a a greyish-yellow colour, and consists of well blended clay. The exterior is smoothed, and is decorated with the same type of cord-like impression as the Vestgård 6 site 2 ceramics right beneath the rim. A few of the sherds show tendencies of wafering; the possible indication of application of pressure, and also seen on the ceramics from Vestgård 6 site 2. A few of the Vestgård 8 sherds are severely eroded, but this is no indication for age as ceramics wither differently in different soils (Orton et al 1993:32).

3.3.2. Slettabø: An Early Neolithic Settlement in Rogaland

Figure 8: The layer III ceramics from Slettabø, Rogaland.

Slettabø is located on the south-western coast of Norway, in Rogaland county, and yields one of the largest ceramic assemblages from the Neolithic in Norway. It has several phases represented by two to three cultural layers separated by layers of sterile wind-borne sand. The deepest layer, layer III, has a median ^{14}C dating of 2730-2870 BCE, and is therefore younger than the Svinesund settlements. However, there is a substantial distance between these settlements, and Slettabø's layer III is still likely to represent the oldest ceramic-using phase in this region (Håkon Glørstad,, personal communication 2008). This is further confirmed by two accelerator datings of food crusts that produce dates down to 4239-4042 BCE and 4271-3975 BCE at one sigma error (see Glørstad 1996:Figur 3). The problems with food crust dating are still unresolved (Fischer and Heinemeier 2003; Persson 1999:31-39), but Slettabø also has a conventional ^{14}C dating that puts it at 3791-3482 BCE with one sigma error (Glørstad 1996:Figur 3). Regarding the transition from organic to ceramic containers, it is therefore still highly actualistic to use Slettabø as a representation for some of the earliest ceramic traditions in the Southwest of Norway.

Arne Skjølsvold, who excavated the site from 1958-1962, states in the site publication from 1977 that layer III represents a hunter-gatherer site of a pre-ceramic phase, and that the 315 sherds excavated in this layer are a result of soil and artefact movements (Skjølsvold 1977:179-180). This is partly because the sherds display features that link them to TRB-ceramics, and according to Skjølsvold it is not conceivable to find such ceramics amongst hunter-gatherers; alternatively he suggests contact between hunter-gatherer groups and presumed agricultural TRB-culture groups. Osteological material from deer and fish indicates a hunter-gatherer subsistence. The site was probably located on an island at the time of the layer III settlement, and the surrounding biotope would have provided good hunting and gathering territory (Skjølsvold 1977:186-188).

With courtesy of the Archaeological Museum of Stavanger, I was given permission to examine the ceramic material excavated from layer III (Figure 8). The evaluation is done macroscopically, as thin section and x-ray diffraction analyses of the total ceramic material has already been done (see Rosenqvist and Rosenqvist 1977).

The ceramic material from Slettabø's layer III displays a good knowledge of pottery making. The potsherds are of a very even thickness – roughly 1 cm – and the coils are virtually invisible. The exterior surface, deduced from curvature, is smooth and undecorated in the bulk of the material. The surfaces are reddish brown to brown, and the interior of the vessel walls are frequently black (Figure 9), probably due to insufficient burn-out of organic matter.

The decorated sherds show the same features as the undecorated. The decoration consists largely of cord stamp impressions. In one case a hole has been made through the vessel wall, possibly for adding a component like a handle or lug (Figure 10). A similar hole was found on a sherd from layer II with contrasting decoration.

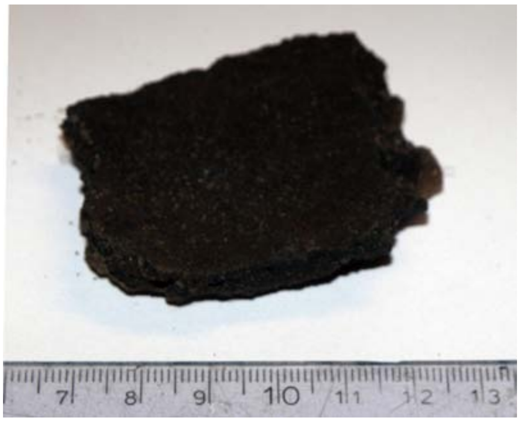

Figure 9: Black and smoothed interior of brown pot. Slettabø.

Some of the rim sherds from layer III exhibit a short neck formation. Others have no remnants of necks, unless the sherds themselves are part of a large neck such as an long funnel neck (see Midgley 1992:Figure 36).

Figure 10: Sherd with hole and fire clouds. Slettabø.

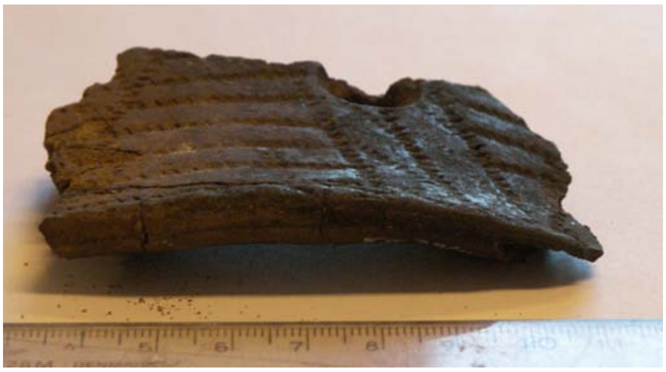

Figure 11: Burnished sherd from layer III. Slettabø.

Traditional TRB features such as the funnel-shaped neck and rounded belly are not really present among the layer III ceramics, which seem to have marginal to no necks and slanted walls. However, a number of layer II sherds had been put in the same boxes, and some of these sherds displayed what seems to be more traditional funnel beaker traits such as rounded bellies. A few rim sherds from layer II have decoration on both sides, which may indicate that they have been slanting outwards like a funnel neck.

Traces of burnishing in the form of faceted stroke marks are visible on several sherds from layer III. Some are also slightly glossy (Figure 11). However, it can be assumed that many of the sherds that are smoothed, and where temper is not exposed on the surface by moisture, have been burnished. Burnishing normally leaves some lustre, but from experience I know that it may have to be undertaken more than once to result in a proper polished surface. Alternatively, these sherds may have been smoothed with a non-fibrous soft cloth such as a skin when leather hard. The decorations are made after the burnish, which means they must have been made when the pot has reached a leather hard or hardened state when burnishing is made possible.

A number of sherds display fire clouds (Figure 10), a sooty deposit that forms as a consequence of being in contact with fuel, but the majority of the material is of an even colouring. The fire clouds may indicate some form of use, although they can also be the consequence of insufficient cover during firing.

The vessel sizes have been calculated by measuring the curvature of 50 rim sherds, and the average diameter is 16,5 cm Ø. The smallest vessel is 6 cm Ø and the largest 28-30 cm Ø. This demonstrates the vast range of pot types they must have dealt with at Slettabø, and with a total of 9876 sherds – 288 rim sherds – from layer II and III, it is a fair assumption that even bigger variations exist.

Most of the thin sections were performed on layer II sherds, which are supposedly 800-900 years younger than layer III (Skjølsvold 1977:179). Since Skjølsvold considers the ceramics from layer II and III to originate from the layer II settlement, there has been no division between the two groups in the analysis. Two of the thin sections showed traces of coiling or ring building. The amount of temper is high – up to 50% of crushed granite or gneiss (Rosenqvist and Rosenqvist 1977:283)

There is a possibility that using the ceramics for cooking has created the exothermic reactions observed through differential thermal analysis, but this could also be the result of the leaching of iron or oxidation of humic acids (Rosenqvist and Rosenqvist 1977:300). Most samples sherds are of an illitic clay type commonly found in eastern Norway. One group in particular has been made from a clay with a high content of organic matter, and has been fired between 500ºC and 850ºC (Rosenqvist and Rosenqvist 1977:302).

3.3.3. Interpretation of the material

On manufacture, not much can be said. The clay used at Slettabø is likely to be Norwegian, possibly imported from the eastern part of the country. The Svinesund sherds are of an unspecified clay source and need further analysis to establish more information. Both assemblages are probably tempered with granite, which is widely available throughout Scandinavia (Garmo and Schumann 1979:112), and which is coincidentally the most common temper for TRB ceramics on the Danish Islands (Koch 1998:123).

The manufacture technique is demonstrated as coiling or ring-building in thin sections from Slettabø, and it is also claimed that pinching was used for smaller vessels (Rosenqvist and Rosenqvist 1977:283; Skjølsvold 1977:75-76). No indisputable evidence for either is seen on the Svinesund ceramics, and alternative techniques can be drawing from a lump of clay, moulding or slab techniques. However, in Scandinavia it has been established that coiling or ring building was dominant (Koch 1998:124-125).

The Slettabø sherds have most likely been burnished, which means polished before firing with a piece of smooth stone or bone when the pottery is in the leather-hard state. The process of burnishing compacts the surface and renders it less permeable (Gibson and Woods 1997:113-115). The burnishing could therefore have some function with regards to retaining moisture inside the pots, for example liquid storage.

Olivier Gosselain has compared firing data collected through ethnoarchaeological research and concluded with severe difficulties in relating firing temperatures to firing techniques, since all data for all firing procedures overlap between 600ºC and 900ºC. From his research in Cameroon he demonstrated that even within bonfire-firings, the temperature curves are extremely variable and the temperatures unstable (Gosselain 1991:244,248). The difficulties with determining firing technique from firing temperature was confirmed by 105 firing sessions from Africa and Asia yielding bonfire temperatures between 550ºC and 950ºC and between 650ºC to 900ºC for non-electrical kilns. This makes it problematic to determine whether characteristics related to temperature result from firings in open or kiln structures (Livingstone-Smith 2001:998,1000). Therefore, no conclusions about firing techniques can be made, but the lack of kiln structures can exclude at least permanent kilns, which are assumed to appear together with wheel thrown pottery (Gibson and Woods 1997:196).

Possible firing techniques include bonfire firing, either in domestic fires or in a large bonfire, or pit firings. Because none of the Svinesund samples show fire clouds, it is likely that they are fired under a cover, such as sand or pieces of broken pottery. This is a common practice and is defined as a firing technique in itself; either in combination with a pit or flat on the ground. However, such structures will yield a much lesser temperature span and this can possibly be an indication that can be encountered through thin sections (Gosselain 1991:Figure 1).

Regarding use, it is interesting to note that both the Vestgård 3 and the Slettabø assemblages ceramics produced several sherds with traces of food crust. At Slettabø this includes sherds that have the oldest dating (Glørstad 1996:12-13). The fire clouds observed at Slettabø could very well result from cooking on open fires, but this is not the case for Svinesund, as no fire clouds are visible on this material. Instead, these vessels may have been used for storage or 'tableware'.

The Vestgård 6 site 1 ceramics possibly correspond stylistically to the Danish Oxie group of TRB. Since the Oxie group has ^{14}C dates representing the timespan 3750 +/- 176 to 3330 +/- 231 BCE (Midgley 1992:497), this is possible. However, there is not much else to support or oppose this statement, as the only diagnostically Neolithic artefacts from the site were the ceramics themselves and a fragmented, possibly point butted axe. The same goes for the Vestgård 3 ceramics which may correspond to the type II and III of Koch's Scanian typology, and which was also found with what is maybe a fragmented, thin butted axe.

The finds from Svinesund and Slettabø, as interpreted here, form the basis for the functional experiments that will follow below. Even if the pots are fragmented, performance characteristics can be deduced from the archaeological material. This means that the replicated pots will be actualistic in terms of wall thickness, temper and manufacture technique, as far as these can be observed. However, the replication of the pottery is only one of the many preparations that must be carried out before the experiments can be initiated. The preparations will follow in chapter 4.

4. Preparations

When preparing for an experiment the main concerns that need to be resolved are the issues of actuality, reliability, and replicability (Coles 1973:15-18; Reynolds 1999:157).

The actuality issue is primarily the question of artefact replication: How detailed a replica is necessary to test the desired parameters? For the experiments in question, the variables to be tested are

1) matter (ceramic versus organic) and

2) shape (shallow and open versus deep and narrow)

The experiments are meant to be actualistic. This means that the experimental matter needs to be consistent with the archaeological matter. In the following section, the background for the choice of raw materials will be summarised.

The clay type and source was unknown for most of the specimens examined, so common potter's earthenware clay was chosen, as clay is completely different from all organics on a structural level. The choice of temper was based on analyses from Slettabø showing its domination in the ceramic material, and the comparison of burnt granite to the Svinesund sherds. Burnt, crushed granite is also very common as a temper in South Scandinavian funnel beakers (Koch 1998:123), and was also found in Neolithic pottery from Auve, Vestfold county (Hulthén 1997:20), and I was, therefore, confident that my using burnt granite as a tempering agent is actualistic. The granite was dug up and burnt on an open fire before it was crushed with a hammer stone. The clay to temper ratio chosen was 4:1, as the potter at Sagnlandet Lejre informed me this was the common ratio for the use of burnt granite in TRB pottery (Inger Hildebrandt, personal communication 2008).

The organic matter for the comparative containers was deduced from pollen charts from the areas in question. No organic containers have been found at neither Svinesund nor Slettabø. The organic containers are therefore *not* actualistic, but the only way to test the functionality of ceramic matter as an aspect of its introduction in the shape of a vessel was to assume the existence of previous containers. There are no traces of inorganic receptacles, and therefore organic containers – which will easily disappear in Norwegian conditions that favour decay by micro-organisms (Renfrew and Bahn 2000:59) are inferred as an alternative.

The shape is chosen as a variable to exclude it as a functional factor: If only one shape of ceramic vessel was tested, it would raise the question whether shape was in fact the determinant of the results. Therefore, two forms are chosen. Both are possibly actualistic. No complete Early Neolithic pots have been found on either of the sites or elsewhere in Norway. A number of rim sherds have been used to determine rim diameter and the results show a variety of sizes. There are also various types of bottom and wall sherds from Slettabø indicating there were a variety of vessel types (Skjølsvold 1977:Fig 31). One of the forms chosen for the experiments is based on the generic similarity between Eva Koch's Type 0, I and II Funnel Beakers from the Danish Islands (Koch 1998:Fig 55,56). These are considered the oldest of the TRB pottery types and correspond temporally with the Svinesund and Slettabø sites. The TRB pottery at Svinesund was interpreted as TRB with regards to the South Scandinavian typology and South Scandinavia is also where most whole TRB vessels are found, thus providing a gauge (Johansen 2004a:22, 2004b:48-49; Jaksland and Tørhaug 2004:90,104). The other is the shape of a small, straight or partly spherical walled bowl. This type is found in the Early to the Middle Neolithic in South Scandinavia (Koch 1998:113). As the Vestgård 3 fragment has been measured to 15 cm Ø and had no visible neck, there is a chance that this shape may be a plausible interpretation.

The manufacture techniques can influence the outcome in terms of porosity, hardness and permeability. As it is documented that coiling or ring building was the dominating constructive method for pottery in the Scandinavian Stone Age (Andersen 1975:57; Koch 1998:124-125; Rosenqvist and Rosenqvist 1977:283; Troels-Smith 1953:30, Fig 27), coiling was chosen as the manufacture technique. There is no structural difference between coiling – spiralling a coil of clay – and ring building – placing consecutive rings on top of each other.

Coiling generally follows an H-pattern or an N-pattern (Figure 12 and 13) in South Scandinavia (Andersen 1975:58; Troels-Smith 1953:Fig 27). Kristina Jennbert has observed a correlation between Ertebølle-vessels and H-technique, and Early Neolithic funnel beakers and N-technique, as has Koch for funnel beakers (Jennbert 1984:48-49; Koch 1998:Fig 96). The coiling was therefore performed in N-technique. Funnel beakers from the Danish islands were constructed on disc shaped bases (Koch 1998:125), so the vessels were built up from a flat slab of clay.

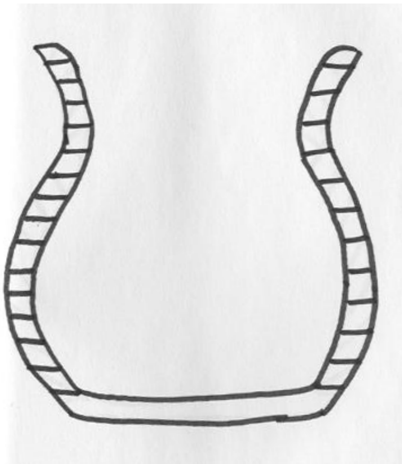

Figure 12: H-pattern when coiling.

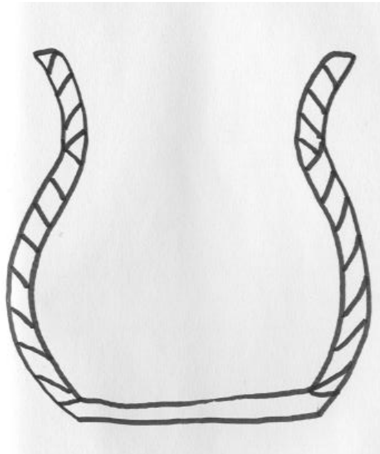

Figure 13: N-pattern when coiling

The N-technique consists of placing the coils on the inside or outside of the vessel wall as it is built up. The coil is then flattened and smoothed upwards on one side and downwards on the opposite. A presumed paddle and anvil may have been used to flatten the walls even more (Koch 1998:125-127; Troels-Smith 1953:Fig 27), but this was not applied for the experimental pieces. Observations about the manufacture process follows in chapter 7 of this thesis.

Half the experimental pots were burnished, since such treatment was observed on the Slettabø sherds, and is assumed to influence the properties of the vessel by reducing permeability and possibly increase the heating effectiveness of pots (Gibson and Woods 1997:113; Orton et al 1993:126). No other surface treatment was given, except a finishing smoothing with the hands.

The vessels were left to dry and then water smoked around a fire before fired on a bonfire. Five of the initially eight small vessels survived the firing, whereas all the nine large pots disintegrated and broke. This was likely due to the fact that these pots were too large to get properly covered by flames, and consequently suffered thermal shock from being colder on the top than at the bottom. The bonfire, therefore, needs to be large enough and the pots should have firewood on all sides including the top. The smaller pots were small enough to be completely surrounded by flames.

Another batch of large pots were made and fired in a ceramicist's kiln. As the sintering and vitrification varies with the clay, not the method of firing, the structure of the clay/ceramic matrix will not differ either (Henderson 2000:132). Even if it did, the ceramic matter is totally different from all the organic matters in question, and a kiln firing does not damage the actuality of the experiment.

The comparative containers were made of pine wood *(Pinus Sylvestris)*, Cattail *(Typha latifolia)* and Birch bark *(Betula pubescens)*. Pine and Birch are found in the pollen charts for areas around Slettabø (Prøsch-Danielsen and Simonsen 2000:50). The same goes for the pollen charts from Svinesund where *Typha* is also found (Høeg 2002:Figur 46 and 47). The pollen charts for the Slettabø area has not yielded any results for Typha, but it must be assumed to have existed in the area in the Early Neolithic (Lisbeth Prøsch-Danielsen, personal communication 2009).

The shape and manufacture of the organic containers were drawn from archaeological evidence elsewhere in northern Europe. Sewn birch bark containers have been found at the Mesolithic *Vis* site in Poland, one presumably watertight enough to hold liquids. At the same site, nets made from sedges (*Carex sp*) were also found, indicating a body of knowledge that includes reed technology (Burov :58,Figure 6.4). Knowledge of basketry is assumed to have been present in the "Norwegian" Mesolithic population, as basket technology is found in fish traps in Mesolithic Denmark, amongst other sites at Lille Knabstrup (Outram 2007:48) and at the Argus Bank site (Fischer et al 2007:175).

The pine wood pails were gouged out from a tree trunk (see Figure 22 and 24) using modern gouges and a mallet. They were not surface treated, and the inner surface was rough from the gouging. The outer surface still has the bark attached. The birch bark containers were folded and sewn with sisal string (see Figure 22), and the baskets were woven in a plain weave with typha leaves. The small baskets were woven from fresh and dried typha, whereas the larger ones were made from dead typha, dried and re-soaked (see Figure 16 and 19). This resulted in the large baskets being more difficult to weave due to the severe brittleness of the leaves. The large baskets do, therefore, not exhibit as tight a weave as the smaller ones that were woven with more flexible leaves.

As a curiosity, two dried but unfired clay vessels were used in the test; one of them lined with pork grease, to see if they could compare in any way to the other containers. These are in no way actualistic, but nonetheless could have existed, since their complete disintegration would ensue in contact with humid soils after deposition. Unfired and greased clay vessels are known to have been used as cooking pots by the Thule population of Alaska and Siberia (Harry et al 2009), and in Western Asia, small unfired clay dishes, cups and vases have been excavated in pre-ceramic contexts (Rice 1999:16).

Having taken into account the level of actuality that is necessary in the replication of the containers, the issue of reliability has to be considered, as the next step in validating the experimental results (Coles 1973:18). In this case, reliability is ensured by the number of vessels involved in each experiment, that at the same time are re-tests in the form of 2 containers of the same material and shape per experiment – twenty vessels were used in the storage experiments, four in the brewing experiment and two in the cooking experiment. In addition, the measurements have been taken under the same conditions for all vessels involved, and in the storage experiments, the temperature was measured both on the surface and in the approximate middle of the stored material. The measurements should be designed to solely measure the parameters predetermined, so that human error can be set aside as far as possible (Reynolds 1999:158). Of course, human error can never truly be refuted, as an experiment relies completely on the researcher. In addition, prehistoric people are likely to have 'made' human error themselves. However, by conforming to the scientific methodology, one is likely to measure factors that are to an extent independent of human error if given the same set of conditions and variables (see Reynolds 1999:158, 162). If the results are inconsistent, the experiment should be repeated to validate or falsify such results, and new parameters for testing should thereafter be considered.

The reliability issue is also linked to the replicability of the study in question. To conform to the scientific experimental methodology, an experiment needs to be repeatable (Coles 1973:17; Reynolds 1999:157), and if so this testifies to its reliability. The replicability issue means that the entire process should be documented and published for others to repeat, and that the variables have to be independent of human error such as sense perception (Odour, appearance etc.). In this study, the replicability is ensured through the scheduling of a re-test for each experiment and the detailed documentation of the process.

5. Experiments and results

5.1. Storage experiments

Two short-term experiments where chosen to represent a hunter-gatherer situation in wooded environments that is most likely characterised by procurement of perishable foodstuffs such as meat, fish or plant foods (Rice 1999:46). The food groups are assumed to illustrate wild plant foods gathered in forest and coastal environments; mushrooms and leaf vegetables. The experiments are meant to examine how ceramics perform as short-term storage containers compared to containers that might have coexisted with pots; especially since the amount of pots can be small such as at Vestgård 6 site 2 and Vestgård 8.

All experiments took place inside a designated room for experimental archaeology. The room had central heating and ventilation and therefore sustained fairly dry conditions.

Twenty vessels were used in the experiments, eight of them ceramic pots. Every vessel type was represented with two specimens, except the unfired clay vessels, of which I had made one larger, lined with grease, and one smaller that was left untreated. The birch bark vessels were difficult to make into predefined shapes, and they came out as one shallow/large vessel, one shallow/small, one wide/large and one wide/small vessel. Thus these results are not per definition replicated as the rest of the vessels, but the results can show tendencies that correlate either to the general shape of most vessels (wide or narrow) or to the material itself.

5.1.1. Mushroom storage

Button mushrooms *(Agaricus bisporus)* were chosen to represent mushrooms in general. Mushrooms are reasonably perishable, and are advised to be kept under certain conditions (Ryvarden 2007:5). The experiment was continued until the contents of the containers was deemed inedible by the present author in terms of appearance, smell, consistency and the presence of mould.

Temperature measurements were taken from between the mushrooms near the bottom of the vessel with a digital thermometer with a margin of error of 0,1ºC. The surface temperature was measured with an infrared thermometer with a margin of error of ±2,5%. The mushrooms were refrigerated beforehand, and the temperatures from day 1 is far below the later temperatures, when one can assume that the mushrooms have reached an equilibrium with the room temperature. Average temperatures are therefore calculated from day 2. This also excludes the presumably faulty measurement in large basket no 1, which is likely to have measured the basket material instead of the atmosphere between mushrooms. The results are presented in Table 2 and Table 3. The room temperature varied between 16^{o} and 18^{o}C during the week the experiment was undertaken.

Mushroom experiment	04.04.09		05.04.09		06.04.09		07.04.09		08.04.09		09.04.09		10.04.09
	Core	***Surface***	**Core**	***Surface***	**Core**	***Surface***	**Core**	***Surface***	**Core**	***Surface***	**Core**	***Surface***	**Core**
Untreated large pot 1	13,4	*13,8*	19,4	*17,4*	18,7	*17,0*	18,7	*17,2*	19,2	*17,6*	18,8	*17,2*	18,8
Untreated large pot 2	13,1	*12,8*	19,2	*16,8*	18,5	*16,8*	18,7	*16,6*	18,8	*17,2*	18,5	*17,4*	18,2
Burnished large pot 1	12,5	*13,0*	19,0	*17,0*	18,4	*17,0*	18,3	*16,8*	18,5	*17,2*	18,3	*17,2*	18,0
Burnished large pot 2	12,5	*14,6*	18,8	*17,0*	18,3	*16,2*	18,1	*16,8*	18,0	*16,8*	18,4	*17,6*	17,7
Untreated small pot 1	11,7	*12,8*	16,7	*15,8*	16,1	*15,6*	16,9	*15,8*	17,6	*16,6*	17,6	*18,2*	17,2
Untreated small pot 2	13,3	*12,0*	17,7	*16,0*	17,5	*16,4*	17,1	*15,8*	18,3	*17,0*	17,8	*17,0*	17,3
Burnished small pot 1	13,3	*12,4*	17,3	*16,4*	17,4	*16,4*	17,3	*16,4*	18,0	*17,4*	18,5	*16,4*	16,9
Burnished small pot 2	11,6	*13,1*	17,4	*16,4*	17,3	*16,4*	16,9	*15,6*	17,8	*16,6*	18,0	*17,0*	16,8
Wood 1	15,1	*13,6*	18,2	*16,8*	18,2	*16,4*	18,0	*17,2*	18,0	*16,4*	18,1	*16,8*	17,3
Wood 2	15,0	*14,2*	18,7	*17,8*	18,1	*16,8*	18,7	*17,6*	18,7	*17,0*	18,3	*17,2*	17,6
Large basket 1	19,8	*13,2*	16,4	*15,2*	17,3	*16,2*	16,7	*16,0*	17,5	*16,6*	17,6	*17,2*	17,1
Large basket 2	15,0	*13,6*	17,8	*16,6*	17,5	*16,4*	16,7	*16,0*	17,7	*16,6*	17,6	*17,0*	17,6
Small basket 1	12,5	*12,4*	18,2	*15,8*	18,0	*16,6*	17,6	*15,8*	17,7	*16,4*	18,2	*16,8*	17,6
Small basket 2	12,3	*11,6*	17,7	*15,8*	17,7	*16,0*	17,3	*16,0*	17,0	*16,2*	17,7	*16,6*	17,6
Wide/small birch bark	12,9	*14,2*	17,9	*16,4*	17,9	*16,0*	18,0	*16,6*	18,0	*16,8*	17,5	*16,4*	16,8
Wide/large birch bark	13,3	*13,0*	17,6	*16,2*	17,7	*16,2*	17,2	*16,4*	17,5	*16,8*	17,5	*16,4*	17,5
Narrow/small birch bark	14,1	*13,8*	17,7	*16,8*	17,7	*16,4*	17,0	*16,2*	17,0	*15,8*	17,1	*16,6*	17,0
Narrow/large birch bark	14,5	*13,8*	17,6	*16,6*	17,7	*16,2*	17,4	*16,4*	17,5	*17,0*	17,5	*17,0*	17,0
Unfired, raw pot	13,3	*13,6*	18,3	*16,2*	17,9	*16,2*	17,7	*16,2*	17,6	*16,8*	17,9	*16,8*	17,3
Unfired, greased pot	13,7	*13,8*	17,9	*16,6*	18,2	*16,2*	18,1	*16,6*	18,1	*16,6*	17,7	*16,8*	17,7

Table 2: Mushroom experiment. Temperatures in degrees Celsius

AVERAGE TEMPERATURES	Core	Surface
Untreated large pot 1	18,93	17,17
Untreated large pot 2	18,65	17,00
Burnished large pot 1	18,42	16,87
Burnished large pot 2	18,22	16,80
Untreated small pot 1	17,02	16,50
Untreated small pot 2	17,62	16,40
Burnished small pot 1	17,57	16,60
Burnished small pot 2	17,37	16,43
Wood vessel 1	17,97	16,57
Wood vessel 2	18,35	17,07
Large basket 1	17,10	16,40
Large basket 2	17,48	16,53
Small basket 1	17,88	16,37
Small basket 2	17,50	16,10
Wide/small birch bark vessel	17,68	16,40
Wide/large birch bark vessel	17,50	16,53
Narrow/small birch bark vessel	17,25	16,43
Narrow/large birch bark vessel	17,45	16,53
Unfired, untreated pot	17,78	16,47
Unfired, greased pot	17,95	16,50

Table 3. Average temperatures mushroom experiment.

The gap between highest and lowest recorded average core temperature was 1,83ºC. The highest core temperatures were measured in the untreated, large pots. These pots show average temperatures of 18,93ºC (vessel 1) and 18,65ºC (vessel 2) with a mean of 18,79ºC. This is 0,5º to 0,7ºC higher than the burnished, large pots which yielded the second highest average of 18,42ºC (vessel 1) and 18,22ºC (vessel 2) with a mean of 18,32ºC. The third highest temperatures were from the wooden vessels with a mean of 18,16ºC.

The large baskets produced the lowest core temperatures with the averages of 17,10ºC(vessel 1) and 17,48ºC (vessel 2) with a mean of 17,29ºC. Second lowest temperatures where found in the birch bark vessels which yielded averages between 17,68ºC and 17,25ºC. The small baskets followed with a mean of 17,69ºC. The unfired pots presented averages right between the pots and the basket-type vessels, with averages of 17,78ºC and 17,95ºC.

The surface temperatures differ slightly. 1,07ºC separates the maximum from the minimum average surface temperature. Here, too, untreated large pots produced the highest mean temperature of

17,08ºC. Burnished large pots with a mean of 16,83ºC and wooden vessels with a mean of 16,82ºC follow, and thereafter the remainder of the measurements cluster around 16,5ºC in average temperature.

It is assumed that core temperature relates to rotting rates, with higher temperatures speeding up bacterial and fungal growth. Surface temperature may recount the mushroom drying rates that is caused by loss of fluids. The higher temperatures were found in the large pots and the deep wooden vessels, whereas the cluster of temperatures around 16,5ºC where all from vessels that allowed more exposure to air, either by material (baskets) or shape (small vessels).

As is seen in Figure 14 and 15, the temperature curves do not differ significantly in any vessels.

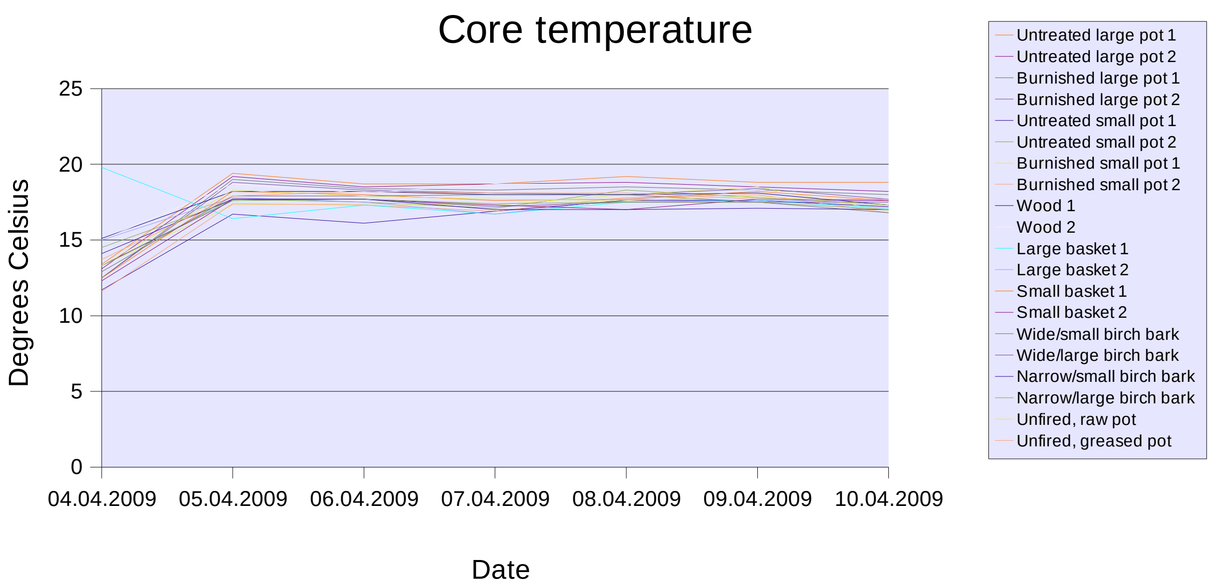

Figure 14: Core temperature comparison, mushroom experiment

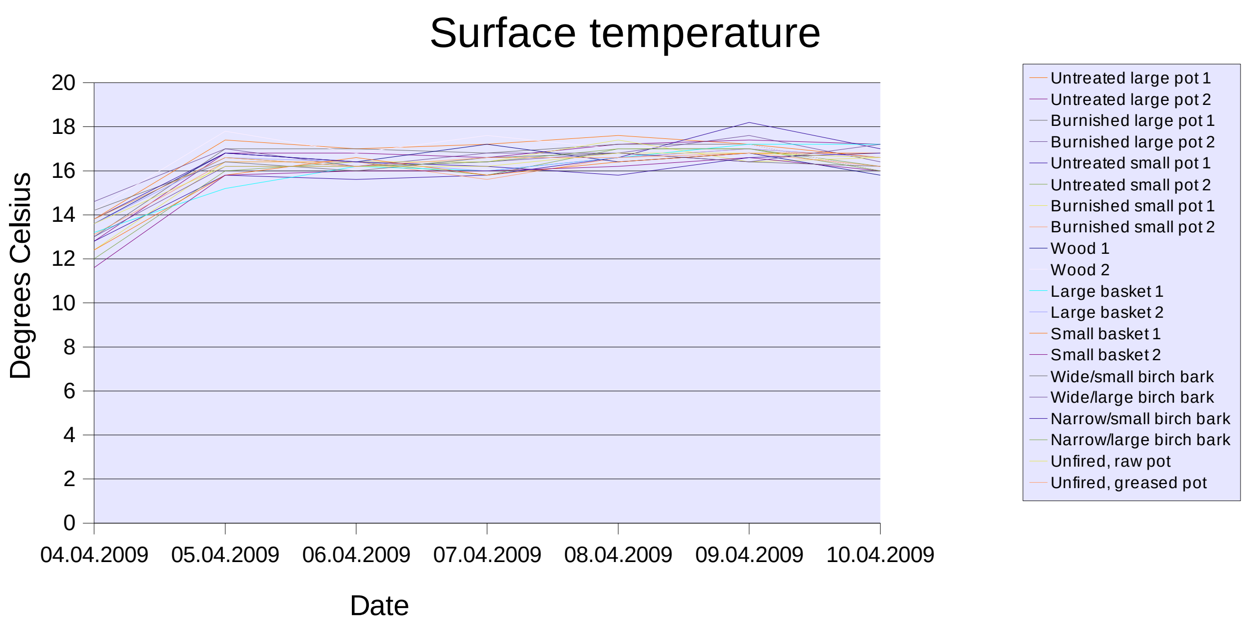

Figure 15: Surface temperature comparison, mushroom storage experiment

Figure 16: Day 3. Drying mushrooms in large basket no 1.

The slight unison variations probably relates to the room temperature, which did vary somewhat during the course of the experiment. The peak in surface temperatures towards the end of the experiment may be connected to water loss and therefore higher temperatures in the mushrooms.

As is clear, the temperature curves do not express significant amounts of information about the differences in raw material capacity. Instead, the observation of the mushroom in the course of the experiment contributed to the results.

From day three of the experiment, significant shrinkage could be seen in vessels that had good ventilation such as the large baskets (Figure 16) and the small ceramic vessels which had the mushrooms stacked to the very rim. In comparison, the large burnished vessels showed no sign of drying (Figure 17). At this stage a slight odour could be detected in most specimens, the only exceptions being the large baskets, one of the burnished, large pots and one of the wooden containers. From day four all specimens smelled, however one of the large baskets, the wide, large birch bark container and the two wooden pails seemed to exude less of an odour than the remainder of the containers. From day five, condensation started to occur in the small baskets and one large, untreated pot, and the mushrooms had gained a somewhat slimy appearance in one large burnished pot. In both small burnished pots, the mushrooms started sticking to the bottom of the vessel.

Figure 17: Day 3. Large, burnished pot no 2.

From day six, the particular smell of rotting mushrooms could be detected in all but two ceramic pots – one small, untreated and one large, burnished – and also in one large basket, one wooden pail and the wide, large birch bark container. Mould started to appear in the two large, untreated pots, and in one small untreated. The wide, large birch bark container also displayed mouldy contents. At this stage, three vessels were deemed to have still edible/palatable contents. These were the two small baskets and the wide, small birch bark container. In addition, the two wooden pails held dried mushrooms on top, but the next layer seemed fresh enough to eat if need be.

At this stage, the contents of most containers started to dry out. One large basket, the wide, small bark container and the unfired, untreated pot had contents that were almost totally dried out. The experiment was ended on day seven, when the contents in all but two containers were deemed inedible due to either mould formation or desiccation. Dried mushrooms can be soaked or eaten as is, but for the purpose of this experiment it would serve no reason to continue the experiment as the mushrooms were unlikely to change their appearance after reaching the dry state. The containers that still held mushrooms fresh enough to eat, were the wide, small bark container and the narrow, large bark containers. With regards to the ceramic pots, these seemed only functional to a certain extent. As Figure 17 shows, the contents retained moisture better than in other containers, but his is also likely the reason why all but one of the early mould formation (day 6) took place in pottery, and most of the first occurences of rotting odour came from the ceramic vessels. Along with the two small baskets, only pottery did also produce condensation from day 5, although not valid for all vessels. In general, the burnished pots retained more moisture and produced more rotting symptoms than untreated pots. This is probably due to the lower degree of porosity that these pots possess.

As for correlations between temperature and the state of the mushrooms, the following tendencies could be detected:

- Mould formation occurred in vessels that held mid range temperatures. The formation of moulds is likely to have more to do with the micro-climate and humidity in each vessel. Most mould formed in ceramic and clay pots.
- Condensation occurred in pots maintaining temperatures of mid to high range. Small baskets, one clay pot and one large, untreated ceramic pot produced visible condensation.
- Drying occurred in vessels that held mid range temperatures and were well ventilated, such as small, wide vessels and baskets. However, this might not be so much a correlation as an equilibrium with the room temperature, or slightly above, due to the lack of moisture in the mushrooms at this stage.

– The last two days of the experiment saw edible contents (as judged by the present author) in only vessels that kept low range temperatures and therefore cooler environments. All six of these vessels were made from organic material, except for the unfired untreated pot, which also produced edible contents.

5.1.2. Ground-elder storage experiment

As a representation of gathered greens, ground-elder *(Aegopodium podagraria)* (Figure 18) was chosen for the second storage experiment. As the experiment took place in spring, Ground-elder had just come up and was harvested and placed directly into the containers, ensuring maximum freshness. The containers were the same as in the mushroom storage experiment, but were thoroughly cleaned. The experiment was continued until the greens were deemed inedible by the author.

Figure 18: Ground-elder (Aegopodium podagraria)

Figure 19: Day 1, ground-elder experiment

Each container was filled with enough ground-elder to be deemed 'full' (Figure 19). The data for the unfired pots on day four were lost in the processing. The data for all vessels are presented in Table 4. Since the ground-elder was harvested on day 1, average and mean temperatures were calculated from day two, when the leaves had stabilised their temperature.

Ground-elder experiment	18.04.09		19.04.09		20.04.09		21.04.09		22.04.09		23.04.09	
	Core	*Surface*	Core	*Surface*	Core	*Surface*	Core	*Surface*	Core	*Surface*	Core	*Surface*
Untreated large pot 1	15,8	*15,4*	17,4	*16,2*	18,8	*18,0*	18,3	*17,2*	19,2	*17,8*	19,4	*18,8*
Untreated large pot 2	15,0	*14,0*	17,2	*16,0*	18,5	*18,0*	17,8	*17,2*	18,6	*17,4*	18,8	*18,4*
Burnished large pot 1	14,5	*15,2*	17,2	*16,8*	18,5	*18,6*	17,6	*17,8*	18,3	*18,6*	18,6	*19,2*
Burnished large pot 2	15,1	*15,2*	16,8	*16,2*	18,2	*18,0*	17,2	*17,6*	18,0	*18,2*	18,5	*18,8*
Untreated small pot 1	15,4	*14,8*	17,2	*16,8*	18,5	*18,2*	18,4	*18,6*	18,9	*19,0*	19,5	*19,4*
Untreated small pot 2	15,8	*15,6*	17,2	*17,2*	18,6	*18,6*	18,4	*18,4*	18,9	*18,4*	19,6	*19,6*
Burnished small pot 1	15,8	*16,8*	17,4	*16,6*	18,4	*17,8*	18,3	*18,4*	19,0	*18,8*	19,4	*19,4*
Burnished small pot 2	15,4	*14,2*	17,3	*17,0*	18,4	*18,4*	18,4	*18,6*	19,0	*19,4*	19,5	*19,6*
Dried wood. large	14,9	*14,8*	17,0	*16,6*	18,0	*18,6*	17,4	*18,2*	18,2	*17,9*	18,4	*18,8*
Fresh wood. small	17,0	*16,2*	17,1	*16,6*	18,2	*17,8*	17,8	*17,4*	18,2	*17,8*	18,7	*18,6*
Large basket 1	14,3	*14,2*	16,7	*16,6*	18,1	*18,0*	18,2	*17,3*	17,7	*19,0*	18,3	*19,6*
Large basket 2	14,3	*14,6*	16,7	*16,6*	18,2	*18,2*	17,1	*17,6*	17,6	*18,2*	18,3	*19,6*
Small basket 1	15,2	*14,8*	17,1	*17,0*	18,2	*18,8*	17,6	*18,4*	17,9	*19,2*	19,0	*20,4*
Small basket 2	15,3	*15,4*	17,4	*17,0*	18,4	*18,6*	17,7	*18,6*	18,2	*19,2*	19,3	*20,4*
Wide/small birch bark	15,8	*16,0*	17,4	*17,4*	18,4	*19,4*	18,3	*19,4*	18,6	*19,2*	19,4	*19,8*
Wide/large birch bark	15,0	*16,0*	17,3	*17,2*	18,4	*18,6*	18,1	*18,6*	18,5	*19,4*	19,6	*19,8*
Narrow/small birch bark	16,4	*16,2*	17,3	*17,0*	18,5	*18,2*	18,1	*18,4*	18,7	*19,0*	19,7	*19,6*
Narrow/large birch bark	15,3	*15,6*	17,3	*16,8*	18,5	*18,2*	18,1	*17,8*	18,6	*18,4*	19,2	*19,2*
Unfired. raw pot	15,9	*15,0*	17,1	*16,8*	18,3	*18,4*	-	-	18,8	*19,2*	19,7	*19,6*
Unfired. greased pot	16,0	*15,8*	17,2	*17,0*	18,4	*18,4*	-	-	18,9	*18,4*	19,4	*19,4*

Table 4. Temperature measurements, ground-elder experiment.

Ground-elder experiment	Core	Surface
Untreated large pot 1	18.62	17.6
Untreated large pot 2	18.18	17.4
Burnished large pot 1	18.04	18.2
Burnished large pot 2	17.74	17.76
Untreated small pot 1	18.5	18.4
Untreated small pot 2	18.54	18.44
Burnished small pot 1	18.5	18.2
Burnished small pot 2	18.52	18.6
Dried wood. large	17.8	18.02
Fresh wood. small	18	17.64
Large basket 1	17.8	18.1
Large basket 2	17.58	18.04
Small basket 1	17.96	18.76
Small basket 2	18.2	18.76
Wide/small birch bark	18.42	19.04
Wide/large birch bark	18.38	18.72
Narrow/small birch bark	18.46	18.44
Narrow/large birch bark	18.34	18.08
Unfired. raw pot	18.48	18.5
Unfired. greased pot	18.48	18.3

Table 5: Ground-elder experiment. Average temperatures.

The highest average core temperature was measured in the untreated large pot no 1, with 18,62°C. Curiously, no 2 had a much lower average temperature (see Table 5). As a group, the small pots were yielding the highest core temperatures, with a mean of 18,52°C for untreated, small pots, and 18,51°C for burnished, small pots. Second were the unfired pots which both held an average of 18,48°C. The birch bark containers produced average temperatures in the range of 18,32°C to 18,48°C, and were therefore third in the ranking. Only after this can one find the large pots with mean temperatures of 18,4°C (untreated) and 17,89°C (burnished). The wood and baskets held the coolest environments, with a 0,8°C difference between large baskets (mean 17,69°C) and the small pots, and wood 0,6 degrees lower (mean 17,9°C) than the small pots.

The highest surface temperatures were found in the wide birch bark vessels (mean 18,88°C) and the small baskets (18,76°C). These were the first vessels to produce thoroughly dried contents, together with the small pots, which had third highest mean surface temperatures (18,41°C). The lowest mean surface temperatures were found in the large, untreated pots, with 17,5°C. The gap between maximum and minimum average surface temperature was 1,56ºC. The lowest average surface temperature was correspondent to the room temperature, but on the last day, all the vessels yielded surface temperatures 1-2ºC above room temperature.

The temperature curves are virtually identical for all vessels (Figure 19 and 20). Curiously, it does not relate to room temperature, which was at 17-17,5 degrees for the duration of the experiment. It may therefore have to do with the chemical, bacteriological or other processes that takes place in the decomposition of ground elder.

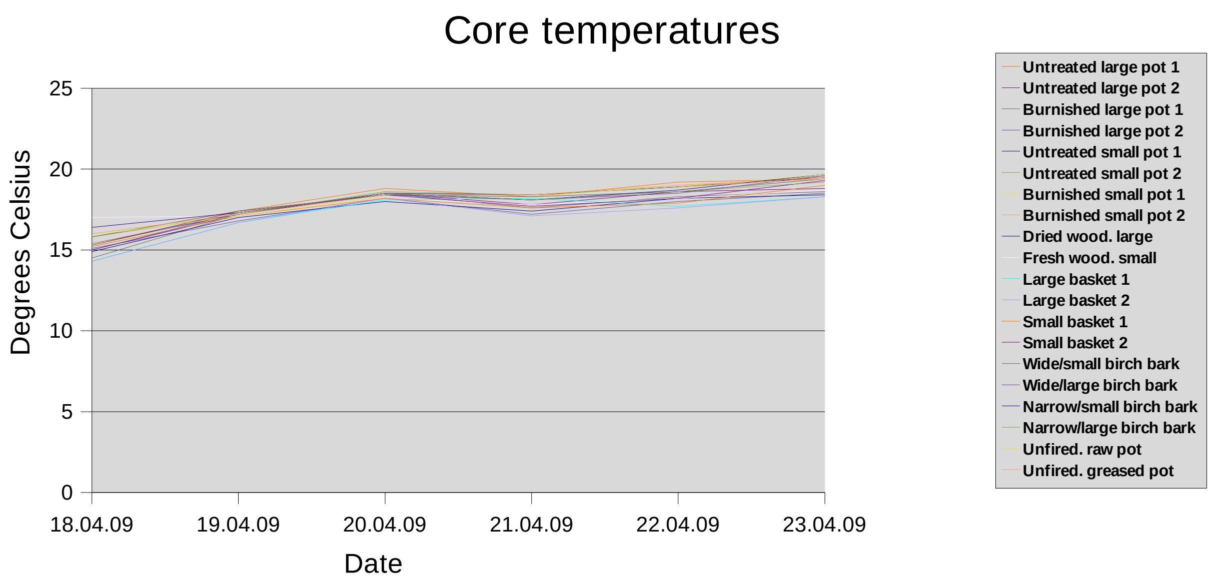

Figure 20: Core temperatures, ground-elder experiment.

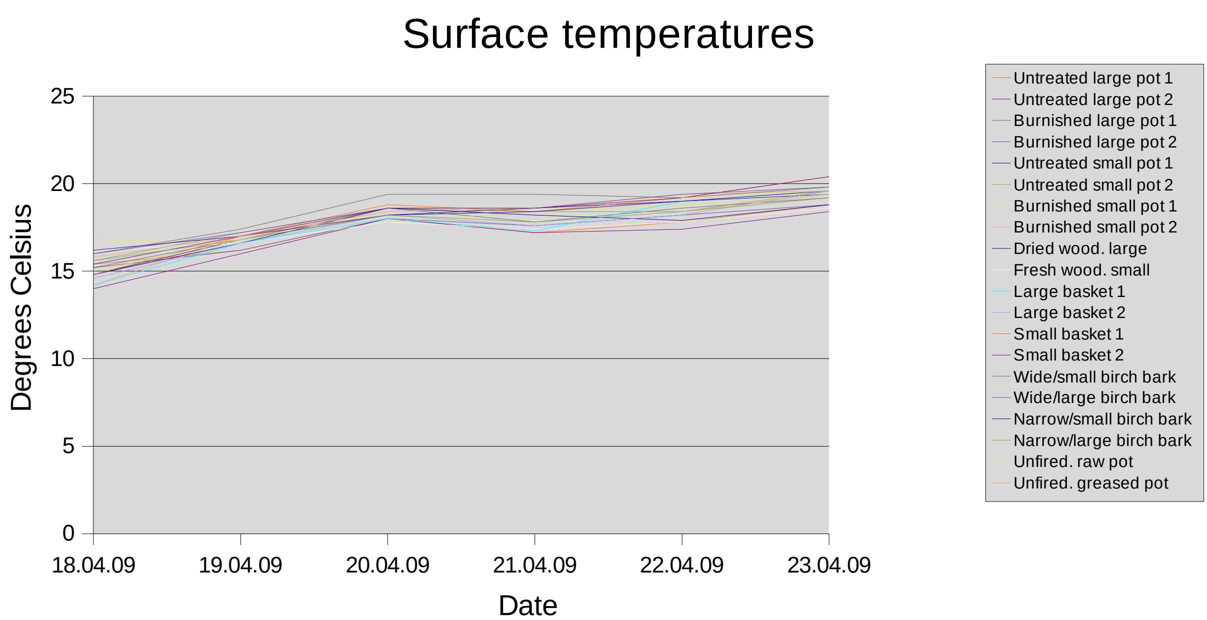

Figure 21: Surface temperatures, ground-elder experiment

The surface temperature measurements show considerable differences between specimens. This has most likely to do with the moisture content of the ground-elder that evaporated in various rates.

The core temperatures differed with 1,5^{o}C between vessels on the last day of the experiment. However, it was the observations of the decay through sight and smell that concluded the functionality issue. After only one day, the ground-elder had collapsed completely in all vessels, and had started drying in the birch bark and basket containers. From day 3, the small ceramic vessels yielded mostly dried contents. Second driest were the baskets, with the large baskets still retaining some moisture at the bottom where the leaves were mostly just wilted. The large baskets, the birch bark containers and the remaining containers produced dry contents from day 4. The wooden containers and the large pots had a layer of dried leaves on top, but still retained sufficient moisture to keep the leaves reasonably fresh at the bottom. From day 5, these, too, were starting to wilt at the bottom of the vessels. Up to this point, no mould formation or decomposition could be detected.

From day 6, a distinct odour could be detected in the experiment space. By now, only a few vessels had remains that were only partially dry: The large pots and the wooden containers. One large basket also had some moisture retained at the bottom. Only the wooden pails did not produce any odour. The experiment was terminated on this day, due to the rotting state of the leaves in all containers but the ones who had thoroughly dried contents.

It was not possible to detect any correlates between rotting rates and temperature. No mould formed during the experiment, although a vague mouldy odour could be felt in some ceramic pots in the first two days of the experiment. This later disappeared and might be remnants from the mushroom experiment that was not completely exterminated by cleaning. Regarding temperature and rotting, the leaves only started rotting on day 6, and in vessels that kept both low, high and mid range temperatures. Since bacteria thrive at moist, warm climates, it is possible that it was the moisture level in each pot that brought on the decomposition. This may be why rotting only occurred in the large ceramic pots and the untreated clay vessel. These vessels are likely to produce more humid micro-climates than organic materials, although a faint smell of rotting could also be determined from one large basket. However, no decaying leaves could be observed in this container.

As for the drying rates, this too had no correlation with temperature. As with the mushroom experiment, the well-ventilated, wide and low forms of containers were the first to produce dried out leaves. However, the lack of correlates does not mean nothing can be said about preservation or storage. instead, the sensual analysis of the experiment can provide valuable information, and at a later stage, the experiment might be replicated with more suitable equipment for measuring, for example, humidity.

The wooden pails seemed best suited for keeping greens fresh for as long as possible. However, if the wanted result is a quick drying process, baskets or wide containers are well suited. In three days, the contents of the low, wide containers were completely dried, without the slightest hint of rot. The pots kept the greens reasonably fresh for four days at the bottom, but above was a substantial layer of dried leaves. However, they would be functional for a very short-term storage of greens. The issue of storing such perishable foods can naturally be discussed. Perhaps containers meant for greens were designed for gathering purposes rather than storage, and from that position pottery is presumably not very functional compared to baskets or birch bark vessels.

5.1.3. Summary of storage experiments

To deem functionality on a sensual basis may not be the most scientific, but it is most certainly actualistic. Today, we judge foods by their appearance and smell before we eat them. However, it is possible to eat the dried mushrooms and ground-elder – and maybe the rotten ones too. Nowadays, dried goods can be soaked or added to stews, or used as condiments. This is habitual behaviour on our part, and dried mushrooms and ground-elder are still edible as is, if somewhat less palatable to us.

The temperature measurements can be used to highlight the conclusions reached by the observation and sensual analysis. In the mushroom experiment, a correlation between temperature and mould, rotting and edibility could be detected. In the ground-elder storage experiment, no such correlates could be found, but conclusions about function could still be attempted through sensual perceptions such as smell and appearance.

For keeping mushrooms, it seems that birch bark is working best of the vessels included in the experiment. Small baskets are also functional. The large baskets were too ventilated, but that may have to do with the brittle state of the typha when it was harvested that prohibited a tight weave. instead, these baskets had to be woven really carefully to not break during manufacture. The results might therefore have been different if both sets of baskets were made with leaves of the same state. Pottery seems to be the medium that most quickly produces rotting mushrooms, however for a shorter time span than five days, they are still reasonably functional, as are almost all the rest of the containers. The choice of container may naturally be more of a cultural or habitual choice than a purely functional one.

For keeping ground-elder, or presumably other greens, none of the containers were particularly functional for keeping the contents fresh. However, all containers managed to keep the ground elder from rotting for four days, even if the leaves were all dried out in a lot of them. If greens were kept for more than a few day's time, for the purposes of having food at all, this would mean that most of the containers are functional to an extent of four-five days.

An aspect of storage that has not been considered in these experiments, is the potential ceramic vessels have for keeping contents cool. As has been seen above, the temperatures measured in the ceramic pots were high to mid range in comparison with the rest of the containers, possibly due to bacterial growth in the humid environment inside the pots. However, in Nigeria in recent years, a refrigerating device has been invented by Mohammad Bah Abbah that consists of one ceramic pot inside another with the gap filled with moist sand. This makes food last longer; fruit and vegetables can be kept fresh for up to three weeks in the sweltering African heat (Taylor 2002:A52). Ceramics certainly have the potential of maintaining a cool environment due to its porosity, as long as moisture is allowed to seep into the pores. This was also observed in the brewing experiment (below), where temperatures of the contents in the ceramic vessels were measured to as much as 4ºC cooler than in the wooden pails. In the storage experiments, moisture was not plentiful enough to create such an environment.

Another aspect of storage that was not considered, was long-term storage. This was due to the mobile hunter-gatherer context the ceramics were found in, which traditionally are assumed to not have such storage opportunities. The discussion has not been concluded, but for now long-term storage facilities amongst hunter-gatherers is not considered for this study (Fischer 2002:376; Rice 1999:12,34).

5.2. Brewing experiments

Christopher Prescott (1996:84) suggests that ceramics were introduced to Norway as part of a ritual package including ground flint axes and grains for ritual feasting. As part of this feasting, intoxication by alcohol is an alternative explanation for the procurement of the small amounts of grain that can be traced in early Neolithic pollen charts. The explicit connection between intoxication by grain products – presumably beer – and pottery is not established by Prescott except for pottery's general role in the Neolithic 'package' (Prescott 1996:78,83-84). One reason for bringing pottery into a context of intoxication may of course be its symbolic significance, but it may also have to do with processing and storage of intoxicating drink. It is evident that a shape like a pot could have been used in collaboration with liquids.

As pottery is used world-wide for storing water or liquids (Henrickson and McDonald 1983:85; Lefferts and Cort 1999:25; Sargent and Friedel 1986:189-190; Smith 1988:914), it was deemed more interesting to examine a potential brewing process in terms of pottery functionality. Beer is brewed in pots among the Sirak Bulahay in Cameroon (Sterner 1989:453), among the Gamo in Ethiopia (Arthur 2003:516) and among the Tarahumara in Mexico (Borek et al 2008). Ethnographic evidence suggest that large jars or pots are strongly associated with beer production and consumption (Arthur 2003:522). The purpose of the following experiment is to deem whether pottery is more functional for brewing beer than certain organic containers, in this case wooden pails.

Anders Fischer (2002:376) points to residues on large funnel neck beakers in one wants to look into potential brewing processes. Alongside the hypothesis that TRB ceramics could have been used for brewing, there is the traces of fermentation that was found in all but one analysed vessels samples from Auve in Vestfold county where three samples also showed possible signs of heating (Isaksson 1997:39).This could be an indication of the brewing process that includes mashing malt on temperatures between 60-70ºC to produce wort (Erik Brinchmann, personal communication 2009).

Alternative containers for brewing in the stone age could have been made out of any functionally waterproof material. Recent research by the present author includes the functionality test of birch bark vessels for holding liquids (Schenck 2007). To procure vessels closed enough to hold liquids proved very time-consuming, and as birch bark has anti-fungal properties due to its content of polyphenolic polymers (Krasutsky et al 2004:13) it was considered unsuitable for fermentation which is a vital part of the process.

A professional brewer, Erik Brinchmann, was involved in these brewing experiments and supplied all information and recipes throughout. As a preparatory experiment, an initial brewing was performed to 'set' yeast in the vessels. 1 kg barley malt (Maris Otter Pale Ale Malt) was crushed on a sandstone slab with a hammer stone and was heated with 7 litres of water to approximately 67ºC for one hour, before sieving away the malt and husks. The heating process is called mashing, and involves enzymes in the malt breaking down starch into sugar in a process called *amylolysis*, so that the yeast can later consume it (Briggs et al 1981:3). The remainder – the wort – was then boiled for an hour to eliminate all bacterial cultures before reintroducing yeast. The yeast was developed in a basis of wort beer (Norwegian: "vørterøl") overnight, and then added to the wort when it cooled. The wort was then distributed between four containers, allowing approximately 8 dl per container. The containers were covered with sheets of paper to hinder infection in the now sterile wort, in which numerous cultures will grow due to the high sugar content (Brinchmann, personal communication, 2009. The room temperature in which the wort was fermented into beer was kept at 17-17,5ºC.

In the brewing experiment only one of each type of container was included, as the intention is to repeat the experiment with the same vessels, and thus ensure reliability. Two large pots, one burnished and one untreated, together with two pine pails, one dried and one freshly made, where selected for fermenting containers. The temperatures of the contents were measured (Table 6) and the wort was tasted daily to gauge the sugar content. Once the sweetness has disappeared, the yeast has consumed most of the sugar and finished fermenting (Brinchmann, personal communication, 2009). After two days, the fermenting had finished in the pottery, visible by the lack of foam on the surface and the layer of yeast at the bottom of the vessel. The pine pails were still exhibiting some foam on the surface, which is indicative of active yeast cultures. The experiment was finished and the containers left to dry.

Vessel	Experiment 1 (core)		Experiment 2 (surface)	
	Day 2	Day 3	Day 2	Day 3
Dry pine pail	19,2	18,4	-	-
Fresh pine pail	18,1	17,3	18,8	17,8
Untreated	15,6	15,5	17,0	16,4
Burnished pot	15,2	15,6	17,2	16,4

Table 6. Temperatures indegrees Celsius measured during the fermentation process.

When dried, the yeast had formed a thick, white coating to the bottom of the pots; less visible in the pine pail. Fresh wort was added as in the first experiment. There was a slight uncertainty as to whether the fermentation would start properly without a starter culture. However, the next day the wort was fermenting vividly, forming a substantial layer of foam on all vessels. To make sure no external bacteria were introduced to the delicate fermenting process, only the content's surface temperatures were measured this time. Day 3 saw a considerable slowing in the fermenting, but all vessels still had foam formation on the surface, so the process was left to stand overnight. The next morning the fermentation was finished in the pots, but still not in the pine pail. However, the pine fermented beer showed a higher degree of sugar loss and therefore fermentation than in the previous experiment, although still a way away from the ceramic pots (Table 7).

The *oechsle* schale determines the specific gravity or relative density of a liquid by comparing it to water, which at 20ºC holds 0ºOe (*oechsle*). The density of water is 1,0 g/ml, whereas the density of alcohol is 0,79 g/ml. Sugar solutions such as worts has a higher density than water. A *hydrometer* is used to measure the difference in density (sugar content) before and after fermentation and so helps monitoring the process. The difference in ºOe can then be calculated into alcohol content (Hartmeier and Reiss 2002:58).

The concluding density measurements for all fermentation in ceramic pots reached the exact same level, which may be an indication of the final level of fermentation. This means that the pots may have finished in the course of the last night, whereas the pine pail contents were still in the process of fermenting when the beer in the pots were not. Consequently, the results in *oecshle* (below) may differ between experiments with regards to the pine pail.

The first round of wort was not measured before fermentation started, as the hydrometer was only available to the author after this point. The end product was measured, and then compared to the next round. The wort from the second experiment measured 75ºOe before fermentation, and the end results were very close or identical to the first experiment's. Therefore, the wort was assumed to hold the approximate same strength in both experiments. The calculations for alcohol content is put in brackets in Table 7.

Container	Experiment 1, 3rd ay		Experiment 2, 4th day	
	Sugar content	*Alcohol*	*Sugar content*	*Alcohol*
Freshly made pine pail	32ºOe	(4,4 vol%)	28 ºOe	4,9 vol %
Dried pine pail	Beer lost	-	-	-
Untreated pot	23-24ºOe	(5 vol %)	23 ºOe	5 vol %
Burnished pot	23ºOe	(5 vol %)	23 ºOe	5 vol %

Table 7. Degree of fermentation after experiment finished.

The closer the results are to 0, the better fermentation. Both ceramic pots reached the same value on the oecshle scale, with the freshly made pine pail a significant distance away. This means that the fermentation was slower or in the pine pail, and may have to do with the anti-fungal properties of pine wood that is part of its natural protection (Iason et al 2005:365). This can be illustrated by the pictures showing how the fermenting was virtually finished on day three in the ceramic pots (Figure 22) whereas the pine pails were still holding a significant amount of actively fermenting wort/beer (Figure 23).

Figure 23: Beer in ceramic pots, day 3 of experiment 2.

Figure 22: Beer still fermenting in pine pail, day 3 of experiment 2.

No difference could be observed between the burnished and the untreated pot. This may have to do with the porosity being the same on the interior surface, since this was not burnished in either. The yeast will have been absorbed in the pores when drying, and may have kept to the same degree.

The conclusion to this experiment is evident. The ceramic pots show a high degree of functionality for fermenting, a process that finishes more rapidly in pots than in pine pails. The brewer, Brinchmann, also noted how the pots, as the only container form, could have been involved in the entirety of the process: from the mashing with hot stones or on or alongside a fire, through the fermentation with added yeast and finally the storage of the finished product. Alternatively, the process could have be undertaken in two independent steps; brewing in one pot and fermenting in a different pot with preserved yeast. The pine pails not only slowed the process of fermentation, but were also difficult to keep without cracking. This has the potential of spilling the contents at uncontrollable stages of the process, even if these containers could also be part of the mashing with hot stones.

5.3. Cooking experiments

As ceramics are often quoted as having a food crust on its interior as, for example, at Vestgård 3 (Johansen 2004:47) and Slettabø (Glørstad 1996:42-45), and as the datings of these particular crusts are indicative of the very Early Neolithic, cooking experiments were conducted to observe functionality in this regard. Two situations were chosen for the cooking experiments, both are believed to be ways of cooking with ceramic vessels:

1) With heated stones (see Woods 1983), where stones are heated on a fire before sunk into a vessel, and
2) Directly on a fire (see Koch 1998:117-118; Skibo et al 1989:132), where the vessel is placed in a hearth or similar structure.

The experiments took place outside in late April, with outside temperatures of c. 15^{o}C.

5.3.1. Heating water with cooking stones

One way of cooking with containers is to heat rocks ("pot-boilers") and place them in the container to heat foods. As a representation of the heating potential for ceramics versus alternative containers, the heating of plain water was undertaken, and temperatures were measured in intervals just after each rock was sunk into the water.

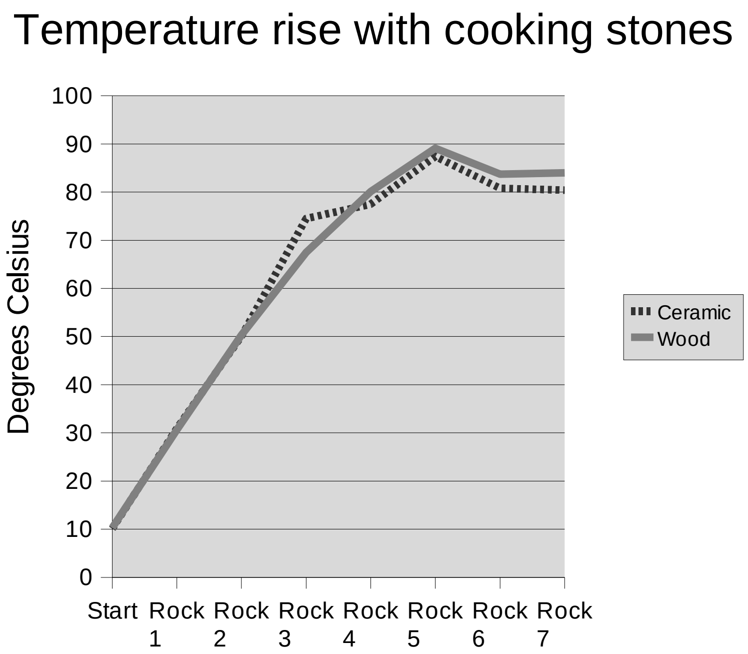

Figure 24: Temperature curve for wooden and ceramic vessel when heating water with cooking stones

Birch bark curls and sets extremely hard when boiling water is poured onto it (Schenck 2007:16), so the material was excluded from the experiment. It is extremely difficult to weave baskets tight enough to hold water, and this was not attempted. Therefore, only wooden containers were assumed to be an alternative to ceramics in a cooking-stone experiment.

1,6 litres of water holding c. 10ºC was poured into one ceramic pot and one wooden pail (Figure 24). Stones of equal sizes were chosen in pairs, so that each stone would maintain the approximate same heat. The cooking stones were heated on a bonfire for ca 15 minutes before being lowered into the vessels, one by one. All in all, seven sets of rocks were used and the temperatures were almost identical for both vessels. The temperature curves can be seen in Figure 24.

No significant difference in function between vessels could be detected. After rock 3, the contents of the ceramic vessel were 7ºC hotter than those in the wooden vessel, but after this the wooden vessel maintained a temperature of 2-3ºC higher than the ceramic vessel. This might be due to the porosity of the ceramic material compared to the wood, which will let moisture seep into the material and keep vessel walls cooler due to the contact with air on the exterior surface.

Figure 25: Heating water with cooking stones. Rock 2 is in the water in both vessels.

However, the differences are rather insignificant in terms of cooking. None of the vessels could be brought to a boil with only one heated rock. The temperature fell and then evened out after rock 5. In terms of cooking foods with cooking stones, both vessels can be determined to be functional.

5.3.2. Cooking directly on a fire

A well-known way of cooking with ceramics is directly in a household fire as the !Kung bushmen have done for generations (Metz et al 1971:230), as do the Sirhak Bulahay (Sterner 1989:453;457) and the Kalinga in the Philippines (Skibo 1992:Figure 4.6., Figure 4.9). Archaeologically, the fire clouds found on numerous pot sherds, amongst others at Slettabø (see Figure 10), may indicate cooking or other activities directly in a hearth. Together with the remains of food crusts this forms the basis for the experiment.

Figure 26: Boiling vegetables on a fire.

A fire was built up and burnt until white-hot. A ceramic pot, filled with water and vegetables, was placed in the middle of the fire. More firewood was stacked around it, and the pot was left until the contents were well done (Figure 26). The soup was eventually eaten, and no difference between this and a soup cooked on an electrical stove, in a metal pot, could be tasted.

The pot provided a high degree of functionality for boiling vegetables. In contrast to metal pots on an electrical stove, the contents kept boiling for a little while after the pot was removed from the fire. This has likely to do with the poor thermal conductive abilities of ceramics (Gibson and Woods 1997:262) that provides a delay in the cooling of the contents. In addition to this, some fire spalling – vertical separation of sherds due to high temperatures – occurred, but the pot did not break. The fire spalling has to do with the unevenly distributed temperatures in the raw material that can result from the combination of poor conduction and the uneven temperatures a fire provides (Gibson and Woods 1997:156). The temper ratio can correct this, and the 1:5 ratio of granite is perhaps not porous enough to prevent rapid temperature changes from affecting the ceramic material.

As a comparison, a wooden pail was soaked in water and placed in the fire in the same way as the pot. No contents were added, as the pail was cracked due to unsuitable storage. Wet contents might have detained the pail from burning, but probably only temporarily, as the pail caught fire almost immediately and burst into flame after only 5 minutes.

Attempts were not made with birch bark vessels, as it has been demonstrated in previous experiments that birch bark readily catches fire, even after having been soaked in water for 5 weeks (Schenck 2007:20). For cooking over a hearth, skins have previously been used in experiments, suspended directly over a fire, but they did not prove functional as the skin both shrank due to the heat and was severely charred (Coles 1973:50-51).

As a conclusion, ceramic vessels can be functional for cooking directly on a hearth. However, more expertise concerning manufacture and use should be of value to achieve the maximum potential for cooking vessels to be used on a fire. The nature of temper – organic or inorganic – does not seem to affect the thermal shock resistance of ceramics (Skibo et al 1989:133). However, it may be that the ratio of temper to clay will be significant, together with the shape and wall thickness of the pottery in question. Such performance characteristics are readily accessible for experimentation.

5.4. The functionality of ceramic vessels as observed in the experiments

The experiments show that ceramic vessels perform differently than comparative organic containers in a variety of procedures. First, it seems that ceramics is not ideal for storing fungi and vegetables for more than a few days. However, in the course of the first three days they seemed to perform equally well as the organic alternatives, and possibly better if the aim is to retain moisture in order to keep contents fresh. If attempts were made at storing fish and meat, it is possible that this property is of significance. For long-term storage, the capacity of pottery to maintain moisture levels may not be ideal, as most such foods are dried. The decay of the vegetable matter in both storage experiments indicate that the moist environment will eventually encourage bacterial and fungal growth.

For fermentation purposes a ceramic vessel is highly functional, as it provides a clean and non-repressive micro-climate. Subsequent storage of alcoholic beverages is unproblematic as the alcohol content prevents bacterial growth. In sum, this means that a pot can be the processing container for the entire brewing process, from mashing to fermentation to storage, as long as a yeast culture is provided at the beginning of the fermentation, either by people, or by the surrounding environment in the form of wild yeast.

For cooking, ceramics seem to be particularly practical, both for use with cooking stones and for placing directly in a hearth. It is not determinately more functional than wooden pails for the use of cooking stones, but for placing in a fire pottery has unsurpassable functionality. Experimenting with temper, surface treatments and wall thickness can provide further insights into the process of cooking in a hearth. As it was, the pot used for this experiment did spall, and is not likely to have the ideal shape for such cooking. Even so, it shows an exceptional functionality compared to organic containers.

6. Discussion

6.1. Accessing the agency of Early Neolithic people in South Norway

The experiments so far have assumed a certain *chaîne opératoire* to have materialised in the Early Neolithic. Of course, there are indications of use in both food crusts and fire clouds, but except for these traces one has to look at the context when it comes to interpreting past activities. A substantial part of this context is the agency of the people concerned, and this section will investigate the indications of agency that should be considered in light of the introduction of ceramics into South Norway.

Of paramount value is the pottery itself. Food crusts, fire clouds and use wear, or the lack thereof, all point to a certain function. Decoration may be a signifier or it may be a result of creativity, but it can also serve as a utilitarian design to aid handling by providing a rougher surface to hold on to (Rice 1999:30). The vessel dimensions and forms may found itself on functional intentions (see Henrickson and McDonald 1983:631-634) or mark a social bond (Armit and Finlayson 1995: 270-271; Gosselain 1992:580). The choices made as part of such archaeological *chaînes opératoires* are not readily identifiable in terms of meaning. However, they contribute to the overall picture and can be assessed as part of the contextual situation of the people in question.

The local context of the finds provides an additional indication of an agency that relates to a *chaîne opératoire* of use. In situations where very few potsherds have been found, like at Vestgård 8 and Vestgård 6 site 2, the scarcity itself can be significant in terms of the value of the vessel. Perhaps was this one vessel especially significant to the people that were settled there, or perhaps it was not: if these people were in fact mobile hunter-gatherers, an alternative is that they had more pottery, but travelled with it to their next destination. The pot(s) may have been insignificant to them and, therefore, left behind, or broken and no longer attractive. On its own, the find context may not provide enough information to make an informed interpretation.

Not only the settlement context may be of value to an archaeological interpretation of a potential *chaîne opératoire* of use. The wider geographical dispersal of a certain culture can be an indication of similar behaviour in a large zone, and hence point to interaction and contact between smaller groups. In the present study, a part of this larger, geographical context is the beginning of the Funnel Beaker Culture that originates between early farming groups on the North European Plain and eventually leaves traces across most of Northern Europe (Midgley 1992:24,31-32). This culture complex has a distinct set of characteristics that binds it together in spite of the great distances: pottery of a defining shape, point-butted and thin-butted polished flint axes, animal husbandry, agriculture and permanent residences and settlements (Koch 1998:111-113 Midgley 1992:317,357-358 ; Solberg 1989:281-283). The TRB culture seems to be the starting point for the earliest ceramics found in South Norway, as the sherds show some degree of similarity to different classifications of TRB ceramics (see chapter 3.2.) The overall context of the TRB should, therefore, be taken into account. At the same time, the local continuity that is observed at all Norwegian sites during the transition from Mesolithic to Neolithic must be of importance, and as there are no traces of agriculture it is assumed that this hunter-gatherer culture survives in an environment that may or may not be influenced by the TRB culture (see Amundsen 2000:114-116; Glørstad 2004:40).

Analogies are valuable tools when interpreting archaeological material. Analogies to other contemporary sites or sites of a similar character independent of time and/or space, are being applied in the archaeological discourse to support an interpretation. Analogies where intentions are known, such as ethnography or ethnoarchaeological studies are particularly valuable when highlighting agency (Fox and Cook 1996:811; Skibo 1992:30; Tite 1999:183). Even so, analogies should be used with caution, and only with a thorough explanation of the purpose behind the comparison. It must be assumed that long distances in time and space gradually remove societies from each other, and therefore using ethnographic material must always come with a degree of skepticism (Meskell 2005:82; Skibo 1992:16-17).

In total, all these factors may play a part when the interpretation of a certain agency, such as the agency concerned with the use of ceramics, is attempted. Below, two modes of agency; pragmatic behaviour and symbolic behaviour, will be discussed. These will be regarded in relation to the Svinesund and Slettabø ceramics, and highlighted through all the means presented above.

6.2. The utilitarian aspect

One mode of agency concerning the use of ceramics is to regard ceramic pottery as purely functional vessels. Numerous studies have tried to establish generalised parameters for different functional categories, based on vessel capacity, orifice size and profiles (Hally 1986; Henrickson and McDonald 1983; Smith 1988), and according to these studies it appears obvious that the shape once decided for a pot had the same motivation as it does worldwide today: containing something either for storage, transport or processing (see Henrickson and McDonald 1983:635-640).

The experiments conducted as part of this study were designed to provide an aspect of the functionality of Early Neolithic pottery. For this, different potentials were explored, primarily:

1) Potential for inhibiting decay of foodstuff through storage
2) Potential for promoting fermentation
3) Potential for resisting thermal stress and open fire

Regarding the first potential, the pots only inhibited decay to a certain extent, and could not measure up to organic containers such as birch bark and wood, that both have anti-bacterial and ant-fungal properties (Iason et al 2005:365; Krasutsky et al 2004:13). Baskets, and presumably other organic fibre textiles, are efficient in terms of ventilation and provide good drying conditions, thereby inhibiting bacterial and fungal growth. However, the experiments took place at a room temperature of c. 17ºC, and the altering of surrounding temperature may lead to different results, such as in the case of Bah Abbah's double pot refrigerator (see chapter 5.1.3.). This also suggests that the seasonal changes in a hunter-gatherer society of northern Europe may result in different choices for same foodstuffs at different times of the year. Perhaps perishable foods could be stored in pottery at certain cooler times of the year, whereas in summer it was better for example to dry them for future storage.

With regards to liquids, the storage potential was not directly explored. No traces of liquid storage are known from the archaeological context of Early Neolithic pottery in South Norway. No solid indications of pastoralism have been uncovered from this period and traces of milk from this period have not been explicitly found. Einar Østmo cites the elm decline (*Ulmus sp*) and small, coexisting traces of pollen as the basis for claiming agriculture in Østfold, where the Svinesund sites are located. However, this trans-European elm decline has later been authenticated to have resulted from an elm-specific disease, possibly caused by elm bark beetles of the *Scotylus* species, and is no longer accepted as a sign of agricultural development alone (Digerfeldt 1997:13; Fischer 2002:347; Peglar and Birks 2004:67). Another indication of pastoralism is the grazing indicator *Plantago lanceolata*, which has only been found in *very* limited numbers around Svinesund and Slettabø (Høeg 2002:Figur 46; Prøsch Danielsen and Simonsen 1997:51). Without some form of animal husbandry, it is assumed that milking an animal is not part of the subsistence pattern. Other liquids that could be contained in the pots are water and blood. As it is known ethnographically that water is kept in pots, even today (Mercader et al 2000:179; Sargent and Friedel 1986:189-190; Skibo 1992:38), it is deemed by the present author to be functional in this regard.

The fermentation process experiment did provide some clues as to the functionality of pottery as a storage container for liquids. Since the liquid contained in the pot seeped through its pores and made it feel cool to the touch, it is assumed that this ability makes up a favourable feature in ceramic vessels. The contents of the pots compared with the pine pails, showed a temperature difference of 4ºC (see Table 5). This points to good conditions for keeping liquids cool, and up to 2ºC lower than the surrounding temperature. Also, the fermentation went on without the intervention of bacteria. If necessary precautions are taken – such as a lid or other form of cover, liquids can be kept fairly cool in ceramic pots.

The potential for promoting fermentation was evident in the ceramic pots. The fermentation went quicker in the pots than in the wooden pails, which may have to do with the impediment caused by the anti-fungal properties in wood. Since no infections gained foothold in the pottery vessels, it can be assumed to provide a rather clean environment that increases the potential for fermentation. The ease with which ceramics can be cleaned with water without causing damage adds to this potential.

However, some form of cover should be part of a brewing package, because innumerable bacteria exist in the surrounding environment and can damage the fermentation process (Brinchmann, personal communication 2009). In this light, one can question the role of the clay discs that have been found in Early Neolithic Denmark (Midgley 1992:Figure 34; Solberg 1989:276). These have been interpreted as baking plates (Gebauer 1995:105; Solberg 1989:276), but could they have been lids for the pots? The nail or finger imprints often found around the edge may be to facilitate the removal of the lid. The potential they bear for being lids has been discussed previously, and it has been stated that they are rather small compared to the vessel orifices and, therefore, probably not lids (Gebauer 1995:105). However, the present author encourages more research directed towards these discs as their current interpretation as ceramic baking plates seems less functional in terms of heat retention than for example stone slabs and the higher capacity they will have for such purposes.

The pottery vessels certainly exhibited a potential for resisting open fires and high temperatures in the cooking experiments. Known from ethnographical and ethnoarchaeological sources to be used as a cooking vessel (Metz et al 1971:230; Skibo 1992:38; Sterner 1989:453;457) this could already be assumed. The ceramics are already fired on temperatures around 1000ºC, and should certainly resist high temperatures up to this degree. The rapid temperature changes, however, are difficult to stand for an untempered pot. Temper corrects this, and it is assumed that the coarser and more porous the pot, the more it can take without breaking when it comes to rapidly changing temperatures (see Bronitsky and Hamer 1986:96). In the present experiment, the cooking vessel did in fact spall, and this may have to do with the ratio of temper to clay, which possibly was to low for cooking. At Slettabø, temper ratios of up to 50% are observed (Rosenquist and Rosenquist 1977:283).

In comparison with the organic materials, it is evident that the pottery is more functional than containers made of wood, birch bark or reeds for placing directly on a hearth. However, wood can compete when cooking or heating liquids with cooking stones. Added to this high level of functionality must be the fact that a ceramic vessel keeps well and needs a minimum of maintenance except for cleaning, whereas wooden vessels warp and need to be kept moist to not crack. Neither do they provide as easy a surface to clean as pottery.

Regarded as a purely functional vessel, pottery does display certain advantages compared to other organic materials. However, one must assume that people both prepared and kept foods, at least temporarily as when transporting gathered goods or keeping food overnight. It must further be assumed that late Mesolithic or early Neolithic people had some form of containers to perform these tasks. The submerged late Mesolithic Ertebølle site of Tybrind Vig has yielded fragments of needle-bound textile and plied ropes of plant fibres (Andersen 1985:68) that indicate an extensive knowledge of organic fibres and probably basketry. At the Upper Palaeolithic site of Dolní Věstonice in the Czech Republic, traces of wicker style basketry has been found (Soffer et al 2000:513), and together this points to baskets being a well-known artefact group from the time of the Palaeolithic to the Mesolithic transition, which has also been demonstrated by finds of basketry fish and eel traps from the Mesolithic sites of Tågerup in Scania and Halsskov S and Ø at Zealand in Denmark (Blankholm 2008:121; Karsten and Knarrström 2001:167). The birch bark vessels from Mesolithic Poland demonstrate that watertight containers were also already a necessity (Burov :58,Figure 6.4). The technology for hollowing out wooden vessels must have been present since log boats have been found in Mesolithic Denmark (Andersen 1985:63-65; Arisholm 2005:41) hollowed out by means of an axe or adze (Andersen 1985:65). Lasse Jaksland (2005) has interpreted the Nøstvet adzes from the late Mesolithic in Eastern Norway to be part of a technology related to dig out logboats.

Regarding pottery as a purely functional vessel needs to take into account whether people did already have container technology. If people were gatherers, they most likely already had receptacles for the purpose of carrying and storing food. It might therefore be fruitful to see the introduction of ceramics into the Neolithic material culture in South Norway as something more than just an adoption of a functional vessel. If pots were in fact a utilitarian artefact category in South Norway in the Early Neolithic, it can also be assumed that more pots would be present at sites. Up until now, all Early Neolithic sites in Norway have yielded only small quantities of pottery, and it must be taken into consideration that the amount increased dramatically in the Middle Neolithic, as is demonstrated by the 40 010 pot sherds found at Auve, Vestfold county, with its bulk of food crust datings lying between 3500 – 2500 BCE with a two sigma error margin (Østmo 1997:15). Based on this and similar tendencies in the earliest phases of TRB in Denmark (Gebauer 1995:108), the hypothesis may very well be that pottery became a utilitarian vessel only later (see Hayden 1995:262-263).

6.3. The symbolic aspect

If the ceramics of South Norway should only be considered a utilitarian container from the Middle Neolithic onwards, the alternative is to look at which other uses it may have had before this point in time. Very often encountered in the archaeological debate regarding Neolithic TRB pottery (Armit and Finlayson 1995:270-271; Hodder 1990b:301; Koch 1998:132; Midgley 1992:479; Shanks and

Tilley 1992:171), the symbolic meaning of ceramics is now considered one important aspect of the use of pottery. Once again, considering various features of the pottery and its context can shed light on the potential symbolic bearings of Neolithic ceramics.

The pottery itself does not provide many insights when looking to the Svinesund and Slettabø sites. The Svinesund pottery is scarcely decorated with only stick imprints or cord impressions in single lines. The Slettabø assemblage shows more variety in the decorations, with a number of sherds exhibiting the cord stamp decór that is becoming more common somewhat later and may display a regional tendency in South-western Norway (Amundsen 2000:45; Glørstad 1996: 6; Figure 8). Stylistic features such as decorations may announce ethnicity as has been demonstrated through ethno-archaeology (Gosselain 1992), which in that case may have differed between Svinesund and Slettabø. Of course, we must remember that this is but an analogy, and that we have no guarantees for decoration actually signifying anything but a normative form of taste. Even so, the theories of Pierre Bourdieu have shown a correlation between determination of what is 'good taste' and a position of power in a society (Bourdieu 2002), and it is likely that a notion of style does signify a norm – a collective agency – of a certain society and is hence symbolic, even if the signified is only "decorative".

The food crusts found on sherds from Vestgård 3 (Johansen 2004:47) and Slettabø (Glørstad 1996:Figure 20) point to a use with foods. Not all vessels have food crusts, and may therefore not have been used with foods, or may have been in use as storage vessels for food contents that do not leave distinctive traces. Another alternative is that they have been thoroughly cleaned – possibly as part of their place as significant, symbolic vessels.

The appearance of certain thinner-walled, presumably finer grained vessels such as at Vestgård 6 site 1 (Jaksland and Tørhaug 2004:89) can indicate a distinctive set of ceramics that have different 'abilities' than the more common type. When the present author examined the assemblage, no such sherds could be easily identified among the 242 sherds from site 1. It would be interesting in any case if the presence of sherds of other types should be confirmed by thin section and so shed more light onto a potential symbolic-utilitarian division between the sherds found at Vestgård 6 site 1. Nevertheless, as there are so few sherds from this settlement, it is possible that all vessels were particularly valued and so there might not be a distinction in this regard.

The overall context must not be overlooked. The hunter-gatherer culture present in South Norway at that time *have* had pottery without taking in the full extent of what is commonly referred to as the Neolithic 'package' (see Armit and Finlayson 1995:267). It appears that pottery arrived in South-eastern Norway together with ground flint axes, fragments of which were found at two of the three Svinesund sites in question. With regard to South-western Norway, these axes were only introduced in the second phase of the Middle Neolithic (Amundsen 2000:107-108), and it may be that the two components were introduced as independent influences of the TRB. Ground flint axes have largely been assigned symbolic meaning as a prestige product (for example Amundsen 2000:109; Fischer 2002:383) Hodder 1990b:301; Mjærum 2004; Tilley 1996:111-115), and if seemingly introduced together with pottery, this may 'transmit' to the pottery when considering the introduction of ceramic vessels. If the introduction of ground flint axes and pottery are unrelated this may indicate two separate sets of meanings that may or may not relate to the TRB culture gaining a foothold further south.

If ceramics were adopted as an influence from the TRB culture, which is most often assumed in the case of Early Neolithic ceramics in Scandinavia (see Amundsen 2000: 109; Gebauer 1995:106; Glørstad 1996:60; Hodder 1990b:185; Jennbert 1984:135, 147-148; Solberg 1989:274), the implications of ceramics in the TRB culture should be reflected upon. Is the symbolic significance altered when the knowledge of ceramic technology is taken in amongst Central-Scandinavian hunter/gatherer groups, or does pottery signify the same meaning in both cultures? This is difficult to assess before the TRB culture and its relation to pottery is elucidated.

Whereas the TRB culture around 4000 BCE seems well established in northern parts of Germany, there seems to be a delay in the adoption of agriculture as a subsistence strategy in southern Scandinavia (for example Hodder: 1990:179; Midgley 1992:394). The earliest TRB society in South Scandinavia does have agriculture, but only very subsidiary, and hunting and gathering seems to prevail as the subsistence strategy of choice (Fischer 2002: 349; Gebauer 1995:99,106; Jennbert 1984:147; Larsson 2007:603; Persson 1999:94; Thorpe 1999:123). A great deal of literature has been devoted to this delay in the change of subsistence, and today a number of researchers lean towards the socio-economic model for the introduction of agriculture in southern Scandinavia. This involves domesticated cereals and animals being part of a new form of social alliances and ritual behaviour in the form of competitive feasting and display (Fischer 2002:382; Gebauer 1995:106; Jennbert 1984:147; Prescott 1996:83-84).

6.4. The socio-economic model and the introduction of pottery

The socio-economic model originates in the debate concerning the introduction of agriculture. This debate has been going on for 150 years: a period dealing with perspectives that have come and gone (Barker 2006:2). A recent view considers takes on the adoption of agriculture into hunter-gatherer societies that have less labour output per calorie than the average farmer and so consideres the introduction of agriculture and its related features as a social more than a subsistence-related process (Barker 2006:390; Hayden 1990; Hodder 1990b:179).

Ian Hodder (1990b) relates the introduction of agriculture and the TRB to the concept of *domus*, which describes a new focus on the homestead and male/female roles relating to the domestic sphere. He sees the axe as the new symbol for male, outside and wild, and the pot as symbolising female, inside and domestic, both artefact categories holding symbolic functions in terms of rituals (Hodder 1990b:301). Hodder points to one of the origins for the transition to agriculture to lie in the social strategy of competitive feasting, exchange and production presumably already established among some Upper Palaeolithic groups. Power was demonstrated in these competitive contexts, and people with power gained the authority to decide what was considered prestigious (Hodder 1990b:292). The notion of domestication is seen by I. J. Thorpe (1999:4) as a way to control the wild, and hence as a metaphor for social control.

Brian Hayden (1990; 1995) elaborates on this view with the concept of accumulation and aggrandizing behaviour as a means to achieve social control. According to Hayden, at a certain point in time – most likely towards the end of the Mesolithic – the concept of economic competition was introduced in various hunter-gatherer societies due to the abundance of resources their technology had made available to them. A resourceful community is a stable community, and it is clear that competitive accumulation of goods only occurred in bountiful surroundings. In an egalitarian society where everyone is likely to have had access to enough food, another outlet for social prestige but 'food provider' may have been what spurred some individuals to take on the role of organising feasts and competitive accumulation (Hayden 1990:57; 1995:258). According to Hayden (1990:58) these individuals where probably aggressive and innovative people, possibly part of the natural genetic variability in populations. They were able to organise, manipulate and manage competitive feasts and rewards of exotic nature. In this way, it is conceivable that the few accumulators or 'aggrandisers' would take in domesticated products as exotica to display and share with the group (Hayden 1990:59). In the case of pottery, such aggrandising behaviour was made evident through the display of new types of foods to share at the feast. Such foods are expected to need new forms of containers to utterly impress the group. If this is the case, specific container forms can be expected, such as food serving plates, bowls and liquid containers, or containers designed to process the new prestigious foods (Hayden 1995:260-261).

The combination of rituals and socio-economic politics is frequently encountered in ethnographic sources, and it seems easy for aggrandising organisers to combine competitive display with rituals and hence further manipulate the population. As a ritual medium, pottery's plastic abilities makes ceramics a good material for materialising symbols (Hayden 1995:261-262).

The deposition of pottery in bogs across the Danish Islands provides further implications of the ritual function certain ceramics may have served (Koch 1998:133-134). A find of 31 Late Early Neolithic pots systematically placed in a pit associated with an overlying stone and wood structure at Ellerødgård, Southern Zealand, seems to be the remains of a ritual feast where the pottery was left behind as part of the ritual (Nielsen 1987:76-77). A causewayed enclosure dated to the Middle Neolithic at Hevringholm, East Jutland, produced what seems to be a pottery manufacture site inside, which may demonstrate that stylistically defining pottery was produced at places of assembly (Madsen and Fiedel 1987:86). Early Neolithic ceramics have also been recovered from graves around Jutland (Madsen 1972:130,134). The ritual purpose of TRB ceramics in Denmark has been elaborated by Anne Birgitte Gebauer, who maintains that only when domestication occurs further south do ceramics in South-Scandinavia take on a function as ceremonial artefacts. Before this, the earlier Ertebølle pottery was in all probability seen as a functional container for cooking (Gebauer 1995:102-105).

If Ertebølle ceramics can be seen as utilitarian artefacts, this poses a problem with regard to pottery's social function as a competitive symbol. However, Ertebølle ceramics have been found in abundant numbers throughout Denmark (see for example Andersen 1975:56; Andersen and Malmros 1985:80; Gebauer 1995:102), and food crust samples have been taken from several sites (Fischer and Heinemeier 2003). Together with the apparent lack of ritual depositions of Ertebølle type vessels, this would point to a more utilitarian mode of use. How pottery was later reformed to become a ceremonial vessel in South Scandinavia is interpreted to depend on the domestication of cereals and animals and the competitive feasting that preceded the establishment of agriculture and pastoralism in northern Europe (Fischer 2002:376; Gebauer 1995: 106-109).

Aggrandising behaviour can be closely related to control with exchange networks that exchange gifts and knowledge, either as a means for maintaining power or to conserve peace and friendship. Such networks have been claimed by Jennbert to be inherent in human beings as a means for contact with the outside world. She proposes that agriculture was introduced into southern Scandinavia by means of exchange of ideas and as a consequence of gift giving bonds between hunter-gatherer and TRB societies. She, too, suggests the competitive or ritual feasting and drinking as an important component and motivation for the adoption of agriculture, and therefore TRB pottery (Jennbert 1984:137-148).

How do the Norwegian finds of Early Neolithic ceramics, then, relate to the present hypothesis? In the following section, I will examine the Svinesund and Slettabø sites and their pottery in light of the socio-economic model concerning competitive feasting and alliances.

6.5. Svinesund and Slettabø: Different regions, same party?

The Early Neolithic pottery chosen for this study consists of assemblages from two very different parts of the country that take ceramics into their material culture at approximately the same time. The pottery sherds display two distinct tendencies concerning style: One eastern, consisting of simply decorated pots possibly with only a low neck or coil-like rim and one western, with cord stamp decoration dominating and possibly higher necks (see Glørstad 1996:Figure 8 and 9). None of them display particularly distinctive TRB features such as the funnel shaped neck and rounded belly (Amundsen 2000:109; Glørstad 1996:46,60). This possible regionalisation in terms of style may indicate different sets of meanings in the western compared to the eastern part of Norway (see

Amundsen 2000:115). It might also indicate that the introduction happened independently. As Lisa G. Bostwick Bjerck has indicated spheres of interaction between Early Neolithic Denmark and Norway that covers a large part of the Skagerrak (Bostwick Bjerk 1988:Fig.1), it is by no means unlikely that there has been contact for example between Jutland and the South-west of Norway. In addition, this has been claimed for the Lista peninsula, within reasonable distance from Slettabø, with regards to the introduction of agriculture (Stylegar 2007:40).

The introduction of polished flint axes as another ceremonial artefact group (Bostwick Bjerck 1988:22) to only the eastern part of South Norway before the Middle Neolithic may point to a contact along other lines, for example through South-western Sweden down to Scania and the Danish islands (Amundsen 2000:105,107-108). However, it may be that these axes were introduced independently, and in a different ritual context from the ceramics.

Regarding the introduction of agriculture to Norway, there is still an ongoing debate whether TRB settlers started farming in the eastern part of Norway, in the county where Svinesund is situated (see Glørstad 2004:57; Prescott 1996:77; Østmo 2007). However, the notion of gift exchange and competitive feasting or conspicuous consumption as parts of a dynamic development of networks between people seems to win territory in the discourse regarding the introduction of agriculture (Amundsen 2000:104; Bostwick Bjerck 1988:30; Glørstad 1996:15; Prescott 1996:84;). However, the introduction of pottery in particular is seldom discussed, except for Øystein Amundsen's master thesis on the regional variations of Early Neolithic ceramics in South Norway (Amundsen 2000). As a general rule, Amundsen considers conspicuous consumption in relation to gift exchange and the exchange of ideas to be the most probable cause for the introduction of pottery in this period.

Below, an evaluation of the conspicuous consumption and gift exchange model will be made with regard to the Svinesund and Slettabø assemblages. This model – the socio economic model put forward regarding the introduction of TRB ceramics in South Scandinavia – will have to be adapted to Central Scandinavian factors. for example, the introduction of ceramics to South Norway is a primary introduction, not a secondary as in southern Scandinavia. Also, the TRB culture did in fact establish in these parts in the Early Neolithic, in contrast to what might have been the situation further north.

To aid the analysis, Prudence Rice's (1999:11-13) model for the origins of pottery will be used. She proposes an aggrandising behaviour, based on Hayden's accumulation hypothesis, and a set of consequences that are most likely to occur if such behaviour has transpired:

1. Early pottery will appear among seasonally mobile societies
2. It will appear among complex hunter-gatherers as part of emerging social differentiation
3. The vessels are expected to be of special-purpose forms related to special foods
4. Container capacities (either size or number of vessels) should be large; adequate for storing or serving foods to a number of people
5. Vessels are expected to be decorated with stylistic information about the aggrandiser's affinity and ethnicity

Each of these repercussions of aggrandising behaviour will be compared to the site context of the Vestgård 3, 6 and 8 and the Slettabø site. Because it is a consequence of Rice's model, the concept of 'complex' hunter-gatherers should be elaborated.

'Complex' hunter-gatherers are defined by Hayden (1995:258) as societies where technological advances towards food procurement and storage are made so that resources become easier to access and consume, and where economic competition is favoured by the resource abundance and increased sedentism. However, the debate is extensive, and more elaborate definitions are necessary. Kenneth Ames (2004:368) argues that 'complex' hunter-gatherers is a residual category for those who are not 'generalised' hunter-gatherers, or rather 'immediate return foragers'. The general opinion appears to be that 'complexity' among hunter-gatherers has to do with increased sedentism, storage, intensive economy and exploitation of a variety of species and habitats, and differentiation between people based on prestige, status or, in other ways, rank (Ames 2004:368; Brinch Petersen and Meiklejohn 2007:186; Keeley 1988:373-374; Price and Brown 1985:10-13). Particularly differentiation between individuals has received great attention and comes across as the most defining attribute to what creates a 'complex' hunter-gatherer society (Sassaman 2004:232). Part of this may be the beginning of specialised crafts that could ascribe a certain rank to the expert craftsperson (Keeley 1988:374).

The notion was, to begin with, that complexity was a natural part of the process of evolution, but this has later been debated (Brinch Petersen and Meiklejohn 2007:186). Whether this is the case is not subject for discussion in this thesis; rather that complex hunter-gatherers were people who expanded their subsistence strategy by a variety of means and differentiated between their individuals, is the essence here. In addition to the social stratification, the greater territoriality and the existence of social networks for exchange in relation to the product of specialised occupations appears defining (Keeley 1988:374).

Aggrandising behaviour is a likely mode of distinction between individuals. A person who wants to give prominence to him- or herself, can do this by claiming possession of a prestigious object or by taking ritual or ceremonial leadership. Conspicuous consumption/competitive feasting and accumulative behaviour fit very well with the definition of social complexity, as it is not only a way of distinguishing between individuals, but also of communication between networks defined by accumulative behaviour of prestige goods.

6.5.1. Svinesund: Competitive or pragmatic?

The first of Rice's suggestions is that early pottery will evolve in seasonal occupation contexts (Rice 1999:12). The chosen Svinesund sites are all situated in a fruitful hunting and fishing context and are assumed to be hunter-gatherer settlements of a group that moves with seasonal changes (Jaksland and Tørhaug 2004:141; Johansen 2004a:29-30,2004b:63-64), so this standard has been fulfilled for the Svinesund sites.

With regards to the complexity of the hunter-gatherer groups of Vestgård 3, 6 and 8, all can be said to have made technological advances to procure foods from the surrounding environment: arrow points for hunting, scrapers/knives for gathering and processing and a potential fish hook from Vestgård 6 (Jaksland and Tørhaug 2004:Tabell 8,Figur 50; Johansen 2004a:Tabell 1, 2004b:Tabell 3). In addition, the abundance of surrounding resources with sea and forest will provide a stable biotope for these people (see Hayden 1995:258), and points to a varied subsistence. Together this may indicate an intensified economy. The degree of sedentism is difficult to assess, but it is possible that Vestgård 6 may have had a larger population than had Vestgård 8 and 3, which may have been hunting camps; although Vestgård 8 was only partially excavated (Jaksland and Tørhaug 2004:141; Johansen 2004a:30, 2004b:64). It is difficult to observe any social distinction unless the presence of ceramics and fragments of polished flint axes signify just that – acquirement of prestigious exotica for demonstration.

So, was the pottery introduced as part of an aggrandising behaviour on a few people's part? The very few finds of ceramics from Vestgård 8 can point to this Late Mesolithic/Early Neolithic site having taken part in social networks with links to South Scandinavia. The pottery is interpreted by Kristine Beate Johansen as potential early TRB pottery (Johansen 2004a: 21-22). The lack of ^{14}C dates for this site and the difficulties connected to dating by shore line and typological dating, opens up the possibility for this being a transitory site that marks the very beginning of the Neolithic, or at least the contact with ceramic-bearing societies. The transitory character has already been determined for the two other sites (Jaksland and Tørhaug 2004:142-144; Johansen 2004b:64), which also produce only small numbers of pot sherds. If so, following the arguments above, there is a distinct possibility that the presence of a few pots together with the few fragments of polished flint axes that have been found on two out of three sites, relates to an accumulation strategy put forward by one or a few individuals of the group to exhibit power and influence.

The next principles have to do with the purpose of the ceramics in relation to conspicuous consumption (Rice 1999:12-13). First, the pottery is expected to exhibit special characteristics that relate to food presentation, consumption and storage. The pot shape found at all three sites will suffice to realise this. At Vestgård 3, food crusts will add to this picture. The vessel capacity issue is fulfilled for all three sites, providing either large enough pots to hold a certain amount of food as at Vestgård 8, or enough vessels to serve a number of people, as at Vestgård 3 and 6. It must be considered that the findings from all the sites indicate a small group of people with regards to settlement size, so that only a small number of vessels are necessary for displaying and sharing exotic prestige foods. Lastly, the vessels should be decorated or otherwise exhibit characteristics of the aggrandiser's affinity or ethnic association. In all three sites at Svinesund, the ceramics display features of TRB culture ceramics, without necessarily being imported. It could very well be that the decorations signal some kind of alliance with the TRB culture or TRB influenced cultures further south.

It seems, then, that the ceramics found at Svinesund may imply that the introduction of ceramics as a part of an accumulating, aggrandising behaviour may well relate to competitive feasting. Whether this feasting was also ritual, and whether the ceremonial concept behind it was in any way related to the polished flint axes that are found in South-eastern Norway, is a question for another debate. However, it seems plausible that they were both part of an aggrandising display of power on behalf of a few individuals.

6.5.2. Slettabø: Conspicuous consumption or sensible savouring?

The same issues will be repeated with regards to the Slettabø assemblage from layer III, which is by now assumed to be the remains of a settlement phase separate from the upper parts of layer II. In contrast to what Arne Skjølsvold's (1977:182-184) interpretation, it is now regarded as a hunter-gatherer culture with ceramics (Glørstad 1996:35).

First, the society in question should be a seasonally nomadic community. Skjølsvold (1977:183) declares it a likely hunter-gatherer settlement. The relatively small number of finds and the hunting related equipment such as arrowpoints implicates a short-term foraging settlement (Skjølsvold 1977:Tabell 1). The location on an island points to fishing as an important activity. The surroundings are also home to a range of wildlife such as deer, seals and whales, otters and seabirds, and the broad leaf forest would certainly yield edible produce, including hazelnuts (Skjølsvold 1977:190-199). The environment can be said to have been generally rich, and a stable subsistence can be expected for the Early Neolithic settlement phase, which points to an intensive economy and the potential for storing abundant foods. The seasonal mobility of the inhabitants is assumed, but Skjølsvold (1977:183) also mentions the possibility that they had more permanent camps elsewhere. The social distinction is possibly implied by the very presence of ceramics.

The next issue that needs to be considered if Rice is right about the aggrandising behaviour and its consequences, is the emergence of social distinction in such a complex hunter-gatherer society. It is clear from the site report that layer III did not yield any trace of agriculture, which for this site is not evident until the later parts of the Neolithic (Skjølsvold 1977:183,189). Interestingly, even then, hunting and gathering seems to make up a large part of the subsistence practice, and only seven fragmented bones of domesticates have been found in layer II (Skjølsvold 1977:189-199). This means that competitive display of exotic foods may have continued well into the later parts of the Neolithic. In any case, it seems likely that the low numbers of ceramic sherds and the absence of agricultural features point to aggrandising behaviour on the part of a few persons.

The vessels found all bear a shape that can be used in combination with foods, either for storage, processing or consumption. They also exhibit food crusts and have evidently been used for cooking terrestrial foods (Glørstad 1996:43). The number of vessels is large enough to display and present special foods in a feasting situation, and upon investigation some of the vessels seem to have been rather sizeable as well. The vessels are distinctively decorated, dominated by cord stamp decorations which seems to symbolise a regional affiliation.

In total, it is credible that the situation at Slettabø may have been a form of aggrandising behaviour with regards to conspicuous consumption. In this region, ceramics must have been introduced independently of the other TRB features, and it is appreciable that the influence was somehow diluted as there are very few characteristics that may be attributed to the TRB culture. The influence may have followed the South Norwegian coastline from east to west as the knowledge about ceramics and its prestigious status was accepted, and along the way a regional element appears to have developed.

6.5.3. Precious pottery

In the previous sections, the relationship between agriculture and pottery has been highlighted as the baseline for conspicuous consumption and aggrandising behaviour theories in Scandinavian archaeological research. The gift exchange that forms the prerequisite for such behaviour seems to originate from the agricultural TRB culture (for example Fischer 2002:376; Jennbert 1984:147; Prescott 1996:84). The question with regard to South Norway would, therefore, be why so very few or no traces of agriculture are found in relation to the earliest pottery. None of the Svinesund sites yield trace of cereals or domesticated bones, and neither does the oldest phase at Slettabø. Why would the ceramic element of the ritual be adopted independently of the domesticated foods or drinks to process and display?

Small quantities of imported cereals may have formed part of the ceremonial feasting or displays, as suggested by Christopher Prescott (1996:84). The meagre evidence of *cerealia* pollen from Østfold county (Bostwick Bjerck 1988:29; Høeg 1988:39; Østmo 1988:234) may support this opinion rather than an actual introduction of agricultural subsistence patterns. Around Slettabø, *Plantago* *lanceolata* occurs for a brief period around 4000 BCE at Romamyra before it recedes and only comes back later in the Neolithic (Prøsch Danielsen and Simonsen 1997:51). No cerealia seems to have been found near Early Neolithic Slettabø.

Imported cereals may have played a part in feasting in the form of porridge, bread, or as more often presumed, beer or other intoxicating drinks. Intoxication is assumed to have played a part in ritual feasting (Barker 2006:145,406; Fischer 2002:376; Gebauer 1995: Prescott 1996:84), and the experiments confirm that pottery is functional as a means of processing grain into beer. Of course, they may have drunk all the evidence, but the total lack of any traces of grain can also implicate that intoxication was not the crucial part of the conspicuous consumption. Perhaps the exotic nature of the pottery itself was sufficient to impress and aggrandise. According to Hodder, it is likely that the pottery and polished flint axes could be dissociated from the *domus*-concept and therefore be taken into the material culture of Early Neolithic hunter-gatherers without disturbing their fundamental lifestyle (Hodder 1990b:185).

Turning again to Hayden's theory of aggrandising behaviour as the stimulus of the emergence of pottery, we can follow his line of reasoning in terms of what makes up a prestige technology and why it becomes prestigious. Based on the aggrandising that results in competitive feasting, Hayden declares that pottery will become a prestige object as the medium for the exotic foods processed and served. The competitive feasting is most likely spurred on by social networks and the manipulation of gifts and debts (Hayden 1995:260). The pottery itself required a new form of knowledge that was not already part of the social set of skills the society possessed. This means that there was likely to occur a vast amount of trial and error, of understanding of new principles in the thermo-dynamic realm and the knowledge about suitable raw material, where to source it and how to prepare it. All in all, this may have made pottery very much suitable for display as a labour-intensive and new product. When the technology was thoroughly understood and incorporated to the extent that 'everyone' could access it, the prestige was lost and ceramics became embraced as a utilitarian artefact group (Hayden 1995:261-263).

In this regard, one can look to the explosion in ceramic material found from the MN onwards, as exemplified by for example Auve and the second phase at Slettabø, which counted 9465 sherds (Skjølsvold 1977:Tabell 1). It is conceivable that the 'news' wore off and the utilitarian aspect of ceramics was truly appreciated. By then, the knowledge of clay, temper and firing would be established and readily available.

In conclusion, it seems pottery as exotica could very well suffice as a means for aggrandising one self and impressing others. It could be that less emphasis was put on the foods, and more on the context in which the ceramics were presented. In this scenario, no domesticated foods would be necessary and the feasting would still be competitive in terms of signalling rank and communicate with allies in the social network.

6.6. What if...? The full extent of agency theories.

To theorise about prehistoric, complex hunter-gatherer agency will present complications when the general aim is to understand the meaning of their assumed behaviour. The fragmented picture left by nature 6000 years later, is one problem: how can one tell what really went on based on what little remains are left? This means that people may very well have done things differently. They may have simply left their pots behind because they deemed it too insignificant to bring to their next location. They may have used them for 'simple' cooking and they may have used them in ways we have no knowledge of, as yet. The problem lies first and foremost in the fragmentary character of archaeological remains, second in the restraint the archaeological discourse poses and third in our own contemporary context.

The fragmentary character of the archaeological finds means that we may be interpreting all potsherds incorrectly; perhaps there were more pots, as the find of one shoulder sherd alone from Vestgård 3 would indicate. Where is the rest of this pot? Perhaps the sherds did not originate from pots at all, maybe they were shallow bowls or entirely different shapes. Likewise, we may have overlooked traces of agriculture or of other agency that 1) was too small to observe during excavation or 2) we were not able to interpret as relevant.

The constraints put upon us by the archaeological discourse is made obvious by this study. Based on a few potsherds alone, the present author would not have been able to make grounded statements about ritual or social behaviour. The discourse forms the basis that we take further, and hence we are constantly kept in check by the research that has previously been conducted. This discourse is founded on both the archaeological tradition and the contemporary politics of academia, on the trends and ideals that make up 'science' and on the results achieved by the previous researcher (Dobres 2000:chapter 1; Hodder 1999:62-65; Shanks and Tilley 1992:22-28). Considering research into the Neolithic, one major bias may be the undisputed focus on South Scandinavia, which has gained a superior position both due to excellent preservation and the early rise of archaeology as a subject field (see Thorpe 1999:63).

The full extent of agency theories and their statement that there lies a distinctive and context-dependent set of social norms, skills and philosophies, is that naturally this goes for present-day archaeologists as well. We are most certainly biased by our own context, in terms of focus – for example do we very often consider social rank in prehistory, because we have a notion of this being both a feature that must have been present (always?) and something of value as a research question. We look at gender roles a certain way (see for example Gebauer 1995:101), and we interpret impressions in terms of what we ourselves would have though today. As an example, Gebauer states that the crude appearance of a certain type of pottery points to its use for cooking rather than serving (Gebauer 1995:105). This may equally well not have been the case, but in today's western society, of course we would only rarely serve food in a crude-looking vessel, especially if we wanted to impress someone.

The contextuality of the researcher must always be considered. If statements are made without a thorough explanation, a whole dimension is lost and the result is a stand-still with regard to understanding other cultures. We may never *fully* decode the meaning behind their material culture, but we will certainly not get there if we only blindly reproduce our own notions of 'appropriate'.

7. Conclusion

The introduction of ceramics into the south-eastern and south-western part of Norway in the Early Neolithic has been discussed above in light of the finds themselves, the experimental results and previous archaeological research on the introduction of agriculture. Four archaeological sites were chosen, as they appear to yield the very earliest finds of ceramic in South Norway: Slettabø in the south west with datings ranging from c. 4200 to 3700 BCE and Vestgård 3, 6 and 8 at Svinesund in the south east, with datings ranging from approximately 4400 to 3700 BCE. All four sites produced fragments of pots with decoration which are interpreted in light of the nearby establishing TRB culture. All sites are assumed to have been populated by seasonally mobile hunter-gatherer groups.

As part of the study of the introduction of a new form of container into the material culture of these hunter-gatherers, it is surmised that the container shape was indicative of a use as a vessel for containing certain contents. The relationship between a container and its contents has been investigated through an assumed actualistic *chaîne opératoire.* Because the ceramics were introduced in a defined container form, it is further assumed that the notion of a container shape was already in existence among hunter gatherers of South Norway. The question of why ceramic containers were introduced was explored through experiments that aimed to provide insights about pottery's functionality compared to alternative containers, assumed to exist at the time. These containers have not been found in Norway, but Mesolithic and Neolithic finds from Northern Europe point to the existence of wooden vessels, birch bark containers and baskets. The raw materials for these organic containers were based on pollen charts for the areas in question.

Three potential capacities were examined in the replicated ceramic vessels, based on archaeological and ethnographical research; the potential capacity for short-term storage of perishable vegetables, for cooking and for fermentation of alcoholic beverages. The vegetable foods chosen for short-term storage were button mushrooms *(Agaricus bisporus)* and ground-elder *(Aegopodium podagraria)* which were used as representations of mushrooms and fresh greens in general. As the people living at Svinesund and Slettabø in the Early Neolithic are expected to be hunter-gatherers, no long-term storage experiment was undertaken. The cooking experiments were exploring both cooking with cooking stones and cooking directly on a hearth, cooking methods known from ethnographic and archaeological research. The fermentation of beer was chosen over other alcoholic drinks, as the introduction of pottery tends to correlate to the introduction of agriculture, and thereby grains, in most of Northern Europe.

Two aspects of function were explored in the present study: the utilitarian aspect concerning the practicality of pottery use, and the symbolic aspect concerning which function a pot could have had as a signifier of symbolic behaviour. The utilitarian aspect was examined with the experiments and the pottery finds as the foremost indicator.

The experimental ceramic vessels did not exhibit any particularly conserving functionality in either of the two storage experiments undertaken. In the storage of mushrooms, ceramic vessels did not perform satisfactorily compared to birch bark and wooden vessels, as it produced a micro-climate that spurred on mould formation and bacterial decay (rot). In this experiment, birch bark and wood proved the better container materials, a likely result of their anti-bacterial and anti-fungal properties. The ceramics performed better in the other storage experiment, containing ground-elder. However, ground-elder is not particularly suitable for storing, as it dries out quickly. It may, therefore, not be an actualistic representation of stored goods at the time. In any case, the pottery was not as functional as wooden vessels, that kept the ground-elder fresher. The ceramic pots worked well up to an extent of two-three days, and if this is the threshold for storing perishable greens, it can be concluded that they worked satisfactorily.

In conclusion, as a container for storage of fresh and perishable vegetable foods, pottery is not optimal as it provides a humid micro-climate in which bacteria and fungi thrive. Nevertheless, the use of ceramics for storing fresh meat and fish, or other goods that may take advantage of cooler, more humid environments can not be excluded.

The brewing experiment demonstrated that the ceramic vessels were unquestionably more functional for fermentation purposes than were the comparative wooden pails. This is presumably due to the anti-fungal properties of wood, in addition to the possibility of achieving a clean micro-climate in ceramic pots due to straightforward cleaning. The porous ceramic material allows for yeast to be stored in a dry, latent state when the vessel is not in use, whereas dry-storage of a wooden pail would most likely lead to cracking of the vessel. The conservation of yeast may have been of paramount importance to the brewing of beer. However, if the yeast was not stored in the pot itself, the pot could be efficiently used throughout the process of brewing: mashing the malt with cooking stones or on a hearth to free the sugars, boiling wort in a hearth, and thereafter ferment it with the addition of yeast.

The ethnographic record indicates that ceramic vessels are practical containers for cooking. The experiments confirmed a high degree of functionality when ceramics are put in combination with fire and heat. Cooking with cooking stones may well have occurred in wood or other vessel materials such as stone or possibly skins, but was nevertheless easily achieved in a ceramic pot. For cooking directly on a hearth, ceramics are beyond doubt more functional than any of the alternative containers because it can be placed directly in a fire without suffering damage. In the hearth experiment, the pot did spall, but this can be corrected with deeper knowledge of temper type and temper ratio. Further experiments with temper and cooking are encouraged by the present author.

The experiments point to a functionality regarding cooking and the preparation of alcoholic beverages. The introduction of agriculture and pottery are in recent Scandinavian research considered to be results of Neolithic exchange networks and social alliances, exhibiting power and influence through conspicuous consumption or competitive feasting and display of grains and grain products. This led into an examination of the symbolic aspect of pottery function in light of the competitive feasting hypothesis.

According to Brian Hayden (1995) and Prudence Rice (1999), conspicuous consumption patterns are assumed to result from the aggrandising behaviour of a few individuals to demonstrate their power. The accumulation of exotica for these purposes are often encountered in complex hunter-gatherer groups with stable access to food and other resources due to their technological abilities and increased sedentism. The security of having access to abundant foods, in combination with the beginning of occupational expertise, is the likely cause of the rank distinction that define complex hunter-gatherer societies, and that is exhibited through acquisition and display of prestigious goods such as alcoholic beverages, grain foods, and pottery as a medium for these consumptives.

In the preceding chapters, both the Svinesund sites and the Slettabø layer III site are found to correlate to the pattern proposed by Rice (1999:11-13) which is indicative of aggrandising behaviour. Her hypothesis is based upon the context of most early pottery finds across the world, whereby pottery appears in a seasonally migrating society, probably as part of a demonstration of social rank. The vessels should have the forms to relate to the consumption expected in competitive feasting, and the number or size of containers that indicates the ability to serve more than one person. The pots should also be decorated to exhibit ethnicity or affiliation. Each of these attributes are found at all sites examined in this study: the complex hunter-gatherer context, the vessel shape and numbers, and the decoration that can be attributed to either the TRB influence in the south-eastern part of Norway, or the cord stamp 'ethnic region' in the south-western part of the country.

Together, these circumstances point to an establishment of competitive behaviour as the incentive for an introduction of pottery into South Norway in the Early Neolithic. However, the pottery arrived without the agriculture that it is often seen in concurrence with, and which is most often perceived as the means to and stimulus behind the competitive feast. This indicates that the pots that were taken into the material culture by the complex hunter-gatherers of South Norway were likely to be used more as a signifier for a new form of aggrandising behaviour rather than as a display for new, prestigious foods. With the use of pottery as part of a competitive consumption pattern, aggrandised individuals were able to display that they maintained contact with the exchange networks and social alliances that brought them new, exotic artefacts and new forms of ceremonial behaviour.

The emergence of pottery as a vessel deliberated for competitive feasting and display seems to be the most plausible rationale for the addition of this new container type in a hunter-gatherer material culture. This assumes that these people already had a set of functional containers for gathering and short-term storage. However, this new medium for holding food and beverage could be enjoyed as a novelty among people who did not take agriculture into their subsistence or ceremonial practice, but still did not want to be deprived of the social alliances and feasting that preceded the introduction of agriculture in northern Europe.

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